Vol. 40, No. 4, 1957.

COMMONWEALTH BUREAU OF HELMINTHOLOGY,
THE WHITE HOUSE,
103, ST. PETER'S STREET,
ST. ALBANS, HERTS.
29.5.58.

THE MALAYAN AGRICULTURAL JOURNAL

PRINCIPAL CONTENTS

THE SRI MENANTI, SENGGARANG AND MUAR DRAINAGE SCHEMES, JOHORE *By. J. N. Wilson.*

PINEAPPLE FRUIT COLLAPSE. *By Anthony Johnston.*

NATURAL CROSS-POLLINATION IN RICE IN MALAYA. *By F. B. Brown.*

A TEST OF SPRAY DEPOSITS ON CACAO FOLIAGE USING A FLUORESCENT TRACER. *By Majorie Henderson.*

INSECTICIDAL CONTROL OF THE DIAMOND BACK MOTH (*Plutella maculipennis* Curt.) ON CABBAGES AT CAMERON HIGHLANDS. *By Majorie Henderson.*

KEDAH PADI PLANTERS BOARD. *By A. L. Barcroft and Othman bin Mohd. Lela.*

MASTER FARMERS OF MALAYA, III. YAACOB BIN SULONG. *By Hussein bin Isa.*

MASTER FARMERS OF MALAYA, IV. MOHAMED YUSOF BIN HUSSIN. *By E. F. Allen.*

NOTES ON CURRENT INVESTIGATIONS AND EXTENSION WORK, JULY TO SEPTEMBER, 1957.

MINISTRY OF AGRICULTURE, FEDERATION OF MALAYA,
Kuala Lumpur.
PRICE $2

SAVAL
PRESSURE SPRAYER WITH AGITATOR

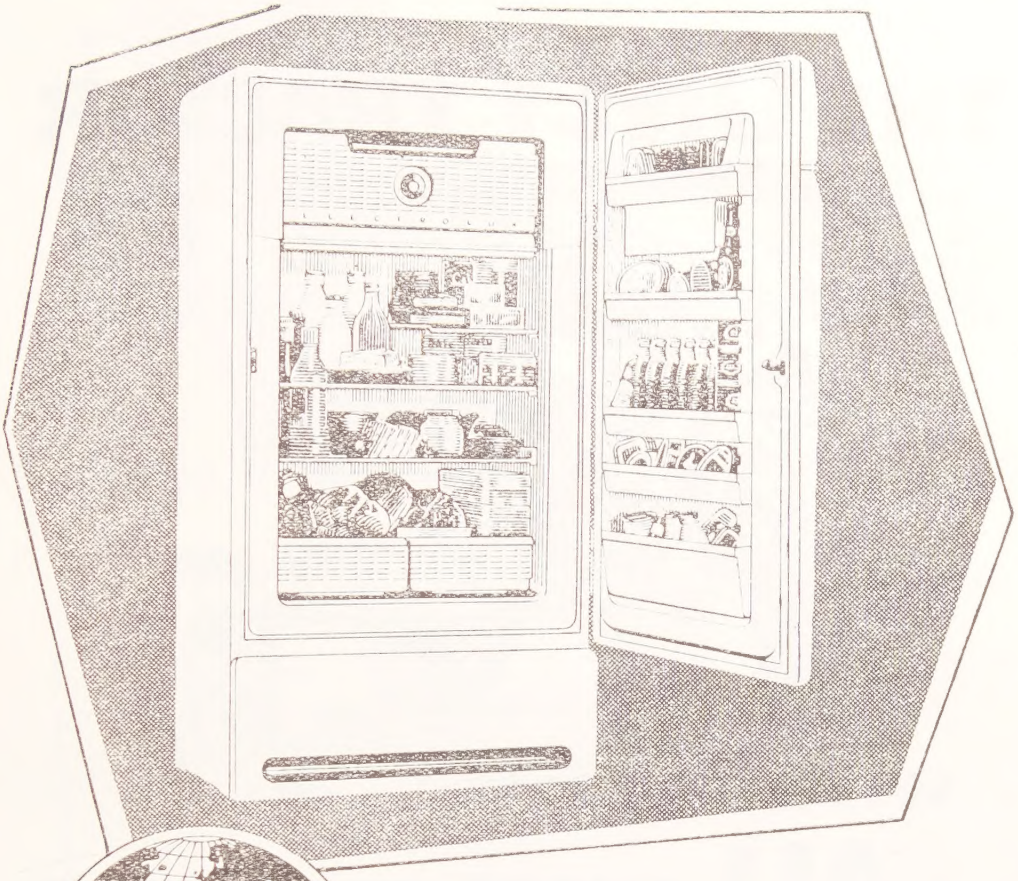
FEATURES:

- Low Pressure Atomizing Nozzles
- Separate Pump and Air Chamber
- Oil Resistant Rubber Hose
- Hard Bronze Conical Valves
- Variable Pump Strokes
- Oil Bath for Pistons
- Agitator Equipment
- Extension Lances

Available in two sizes: Standard 3½ gallons & 2.2 gallons.

LINDETEVES (M) LTD.

SINGAPORE - K. LUMPUR - PENANG - IPOH - JESSELTON.



Electro-lux

the world mark

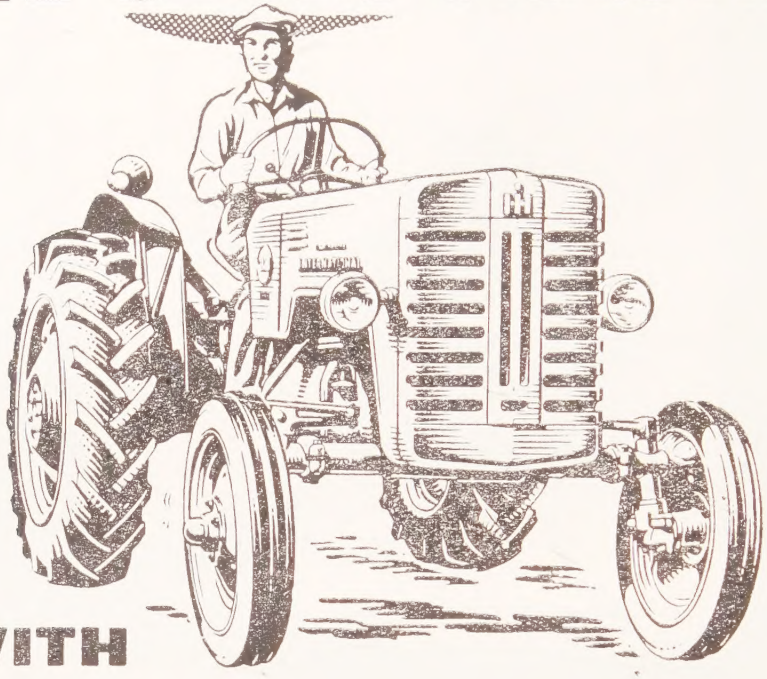
More than 20 million products make Electrolux a household name the world over.
Electrolux refrigerators are on active service in 100 countries on 5 continents.
There is an Electrolux refrigerator for every need; for operation by kerosene, gas or electricity. Every Electrolux refrigerator carries a 5 year guarantee.
For quality and service — Electrolux.

KEROSENE OPERATION

ELECTROLUX

Sime Darby 美那森

THE ONLY TRACTOR



WITH

ALL THESE FEATURES

McCORMICK INTERNATIONAL

B250

DIESEL TRACTOR
30 B.H.P.

★ Differential Lock ★ Disc Brakes
★ REALLY 'Live' Hydraulic System
★ Reversible 3-Point Linkage
★ Inbuilt Weight Transfer
★ Automatic Pickup Hitch
★ Up-to-the-minute Styling
★ Unmatched Driving Comfort

INTERNATIONAL HARVESTER

FOR FURTHER INFORMATION, SALES AND SERVICE
ENQUIRE OF THE SOLE AGENTS

UNITED ENGINEERS LTD.

SINGAPORE, KUALA LUMPUR, IPOH, PENANG, MALACCA, SANDAKAN.

DAIRY ENGINEERING

BY THE **APV**

COMPANY LTD., of CRAWLEY, ENGLAND
and A.P.V. Engineering., Calcutta, India.

for
APV PARAFLOW Short-time Pasteurization Plant
Capacities—100 to 2,500 G.P.H.

Village Co-operative Sterilized Milk Plant
Capacity 200 gallons per day.

Plant for Butter, Cheese, Condensed and Dried Milk processing factories.

Call upon APV for expert advice on all milk processing problems.

APV also produce
Plant for pineapple and other food and potable liquid processes and for the chemical industries.

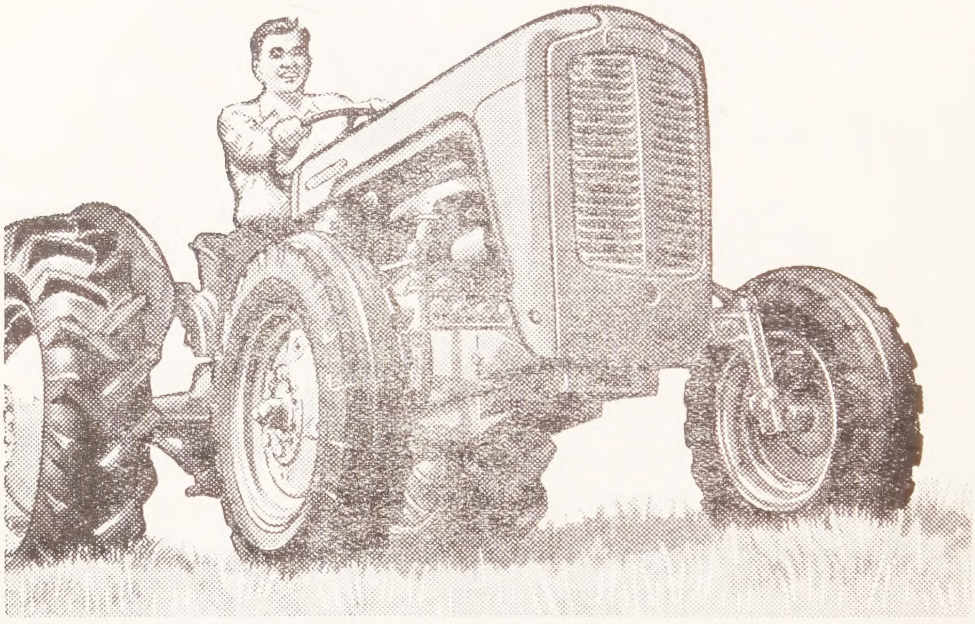
Consult

Guthries Engineering

SINGAPORE • KUALA LUMPUR • PENANG • IPOH • MALACCA • SEREMBAN
KOTA BHARU • TELUK ANSON • KUANTAN • JESSELTON • SERIA

FERGUSON 35

outdates every other tractor!



Never before a tractor with all the features you need!

Look carefully at the new Ferguson features below. Compare the Ferguson 35 with other new tractors. You'll see how it outdates them—makes them old-fashioned already. And remember—the Ferguson 35 has what no other tractor has . . . the all-important basic benefits of the Ferguson System . . . tried, tested and now *improved!*

NEW *NEW Hydraulic control!*

NEW *NEW Two power-take-offs in one!*

NEW *NEW "Two-way" depth control!*

NEW *NEW Gear box!*

NEW *NEW Constant overload release!*

NEW *NEW Independent brake pedals!*

NEW *NEW Great diesel engine—37 brake horsepower!*

NEW *NEW Safety, comfort and convenience features!*

With all these vital advantages, the Ferguson 35 gives you what you need from a tractor; greater output—in less man-hours. It raises your margin of PROFIT. *See us about a free demonstration today!*

BORNEO MOTORS LIMITED

SINGAPORE — K. LUMPUR — MALACCA — SEREMBAN
IPOH — PENANG — BUTTERWORTH — JESSELTON.

COVER CROP SEED

SUPPLIES FROM 1958 HARVEST
AVAILABLE IN APRIL / MAY

CALOPOGONIUM MUCUNOIDES

CENTROSEMA PUBESCENS

PUERARIA JAVANICA

WHITTALL & CO., (MALAYA) LTD.

P. O. BOX 193

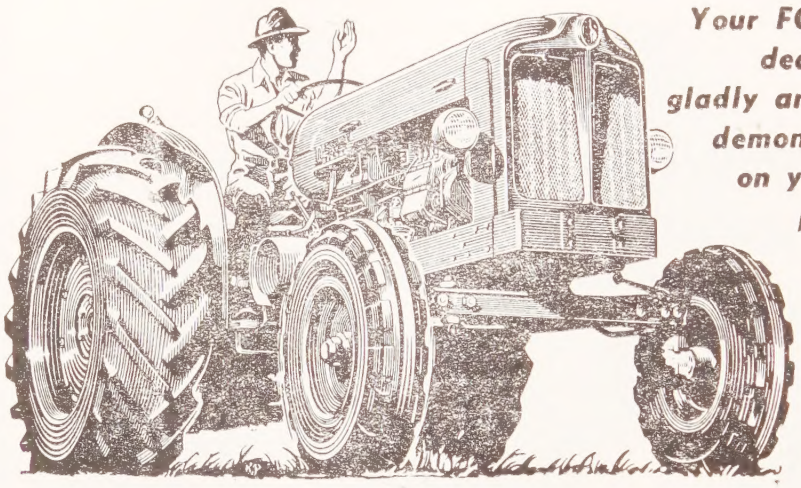
KUALA LUMPUR.

DON'T CHANCE YOUR INVESTMENT!

MAKE SURE WITH A

FORDSON MAJOR

THE **PROVED** TRACTOR



Your FORDSON dealer will gladly arrange a demonstration on your own property

PROVED in

POWER ☆ ECONOMY ☆ PERFORMANCE

THE FORDSON MAJOR DIESEL HAS ALWAYS OFFERED YOU THESE FEATURES

- 40.5 BRAKE HORSE POWER AT 1,600 R.P.M. WHICH MEANS MORE POWER WITH LESS ENGINE WEAR AND FUEL USAGE
- 36 HORSE POWER AT THE DRAWBAR—THE POWER THAT DOES THE WORK
- AN IMMENSELY STRONG 5-BEARING CRANKSHAFT
- A GEARBOX WITH 6 FORWARD SPEEDS AND 2 REVERSE SPEEDS—
- THE MOST ECONOMICAL SPEED FOR EACH TASK
- 14 x 30 REAR TYRES ENSURING GREATER TRACTION AND LESS LOSS OF POWER BY WHEEL-SPIN
- CAR TYPE CONTROL—LESS DRIVER FATIGUE—MORE WORK DONE

AN ADVERTISEMENT OF

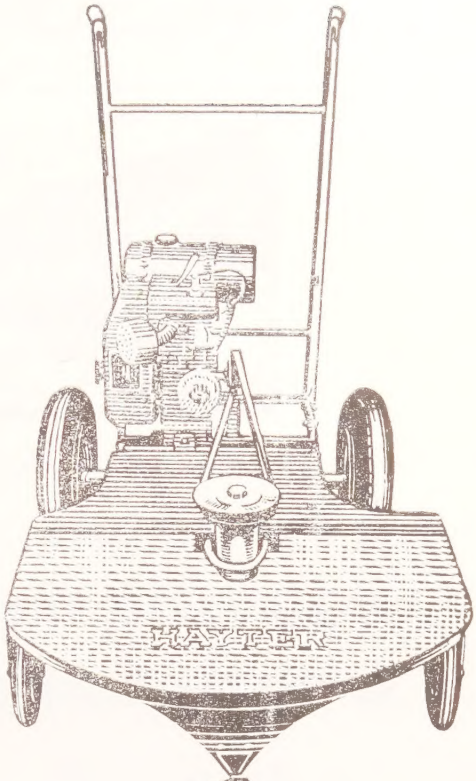
FORD MOTOR CO. OF MALAYA LTD. SINGAPORE

FORDSON MAJOR TRACTORS ARE SOLD AND SERVICED IN SINGAPORE AND FEDERATION OF MALAYA BY SIME DARBY & CO., LTD'S.

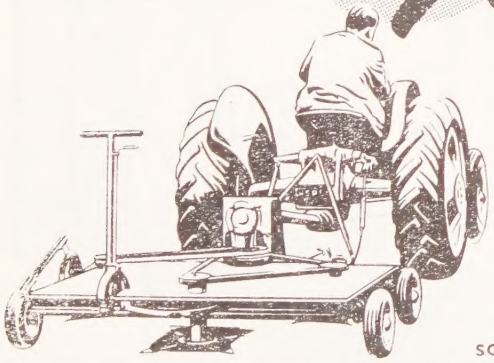
TRACTOR AND HEAVY EQUIPMENT DIVISIONS AT SINGAPORE, KUALA LUMPUR, MUAR, MALACCA, SEREMBAN, PORT SWETTENHAM, TELOK ANSON, IPOH, TAIPING, PENANG, ALOR STAR AND KOTA BHARU AND IN NORTH BORNEO BY HARRISONS & CROSFIELD (B) LTD. AND IN SARAWAK BY SIME DARBY (BORNEO) LTD.

it revels in the rough

The "Hayter" Motor Scythe, illustrated at right, is in its element in tough grass or lallang, on padang, sports field or private lawn. Of sturdy build, and easy to handle, the "Hayter's" cutting height may be quickly and positively adjusted. The actual cutters may be quickly sharpened with an ordinary reaper file. Powered by a MARK 12—4-stroke—"Villiers" engine (guaranteed 6 months), this is a scythe you can rely on.



ROTARY
HAYTER Grass Cutter

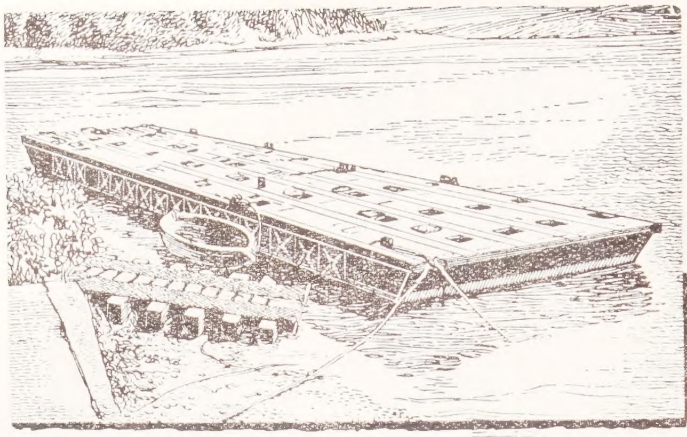


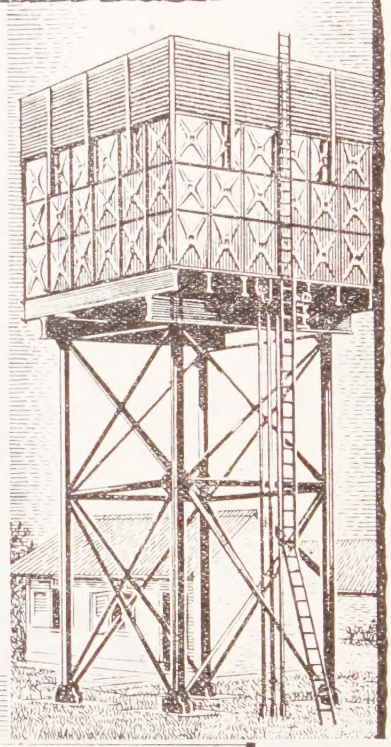
The heavier model, at left, is an invaluable machine on Plantations, Estates, Padangs and Airstrips. We would welcome the opportunity of discussing this machine's advantages with you.

SOLE AGENTS

JAMES WARREN

KUALA LUMPUR · SINGAPORE · IPOH · PENANG

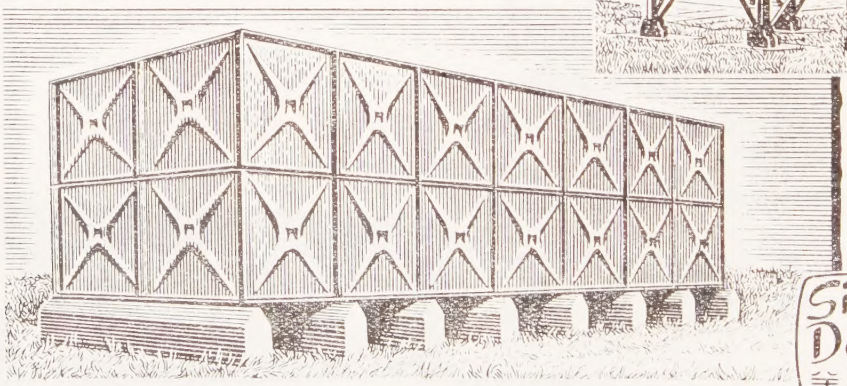




★ PONTOONS
★ ELEVATED TANKS
★ OIL STORAGE TANKS

All sizes available
from 400 gallons upwards

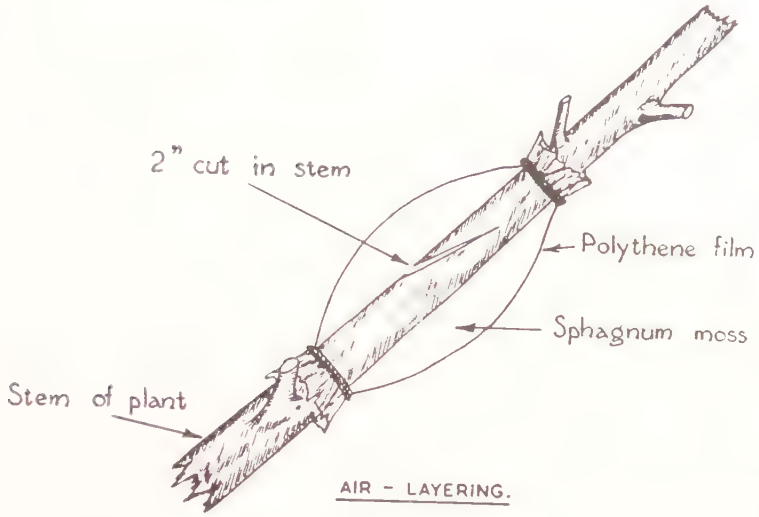
BRAITHWAITE



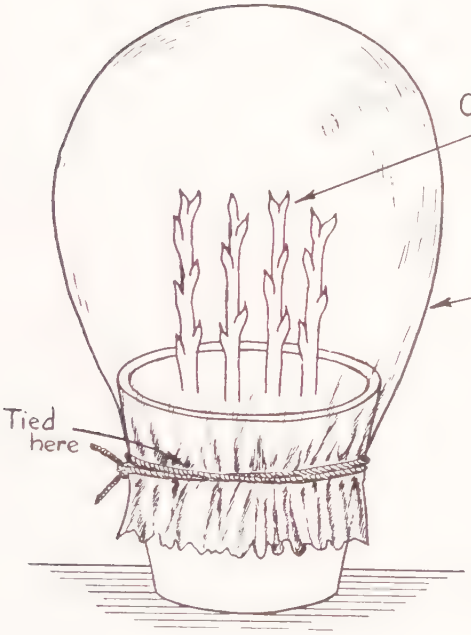
Sime Darby 美那森

'VISQUEEN'

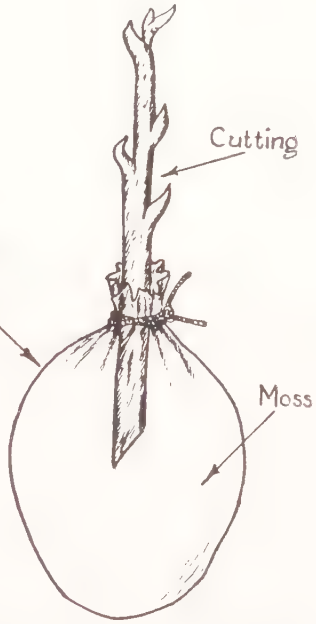
the polythene film with innumerable uses



AIR - LAYERING.



ROOTING CUTTING IN FLOWER POT.



SINGLE CUTTING WRAPPED IN POLYTHENE FILM.

ICI FOR AGRICULTURE

Insect Pests of Economic Importance

Plutella maculipennis Curt.
(The Diamond Back Moth)

During recent years there have been increasing numbers of reports of the depredations by the pale green caterpillars of the Diamond Back Moth on Cruciferous plants, particularly cabbage, from both the vegetable growing areas of the Cameron Highlands and Singapore Island. It is stated, but not proved, that the insect has become resistant both to BHC and DDT. In order to control the Diamond Back Moth, and also such insects as Scale Insects, Woolly Aphid and Red Spider mites, which are not markedly susceptible to BHC or DDT I.C.I. (Malaya) Ltd. have introduced **'COCK'S HEAD'** brand **MALATHION INSECTICIDE.** This preparation contains 50% *Malathion*, a relatively non-poisonous insecticide, which is highly effective against these pests, at a high dilution.

ICI
MALATHION INSECTICIDE
('Cock's Head Brand)

THE

Malayan Agricultural Journal

Edited by the Publications Officer with the Assistance of the Publications Committee.

Vol. 40, No. 4. **1957.**

Page

Editorial 239

ORIGINAL ARTICLES

The Sri Menanti, Senggarang and Muar Drainage Schemes, Johore. *By J. N. Wilson, B.Sc., M.I.C.E.* 241

Pineapple Fruit Collapse. *By Anthony Johnston, B.Sc. (Hons.) A.I.C.T.A.* 253

Natural Cross-Pollination in Rice in Malaya. *By F. B. Brown, B.Sc. (Hons.), Dip Agr. Sci. (Cantab.)* 264

A Test of Spray Deposits on Cacao Foliage Using a Fluorescent Tracer. *By Majorie Henderson, B.Sc. (Hons.), Dip. Agr. Sci. (Cantab.).* 269

Insecticidal Control of the Diamond Back Moth (*Plutella maculipennis* Curt.) on Cabbages at Cameron Highlands. *By Majorie Henderson, B.Sc. (Hons.), Dip. Agr. Sci. (Cantab.)* 275

Kedah Padi Planters Board. *By A. L. Barcroft, B.Sc., and Othman bin Mohd. Lela* 280

Master Farmers of Malaya, III. Yaacob bin Sulong. *By Hussein bin Isa* 284

Master Farmers of Malaya, IV. Mohamed Yusof bin Hussin. *By E. F. Allen, M.A., Dip. Agr. Sci. (Cantab.), A.I.C.T.A.* 288

Notes on Current Investigations and Extension Work, July to September, 1957 290

STAFF NOTES

Awards, Promotions, etc. 298

STATISTICS

Market Prices and Production and Export Data for Selected Agricultural Products 300

Meteorological Summaries 309

THE MALAYAN AGRICULTURAL JOURNAL

The Journal, which is published quarterly, is designed to present — as far as possible in non-technical terms — the results of the agricultural research, investigation and extention work performed by the Department of Agriculture and it draws attention to the results of work of a similar nature in other countries.

The price of the Journal is $2/- per copy or $8/- per annum, post free, in Malaya; it is $8.50 or £1 sterling, post free, outside Malaya.

The Journal and other publications may be obtained from the Department of Agriculture, Kuala Lumpur, Federation of Malaya, or from the office of the Commissioner for Malaya in the United Kindqom, 57, Trafalgar Square, London, W.C.2.

COMMITTEES OF THE DEPARTMENT

The Standing Committee on Investigations:

The Deputy Director of Agriculture. **(Chairman).**
The Assistant Director of Agriculture (Research).
The Assistant Director of Agriculture (Field).
The Senior Agronomist.
The state Agricultural Officer, Selangor.
The Agronomist-in-charge, Federal Experiment Station, Serdang.
The Publications Officer. **(Secretary).**

The Publications Committee:

The Director of Agriculture, Federation of Malaya. **(Chairman).**
The Deputy Director of Agriculture.
The Assistant Director of Agriculture. (Research).
The Assistant Director of Agriculture (Field).
The Senior Agronomist.
The Publications Officer. **(Secretary).**

The Examinations Board:

The Deputy Director of Agriculture. **(Chairman).**
The Assistant Director of Agriculture (Research).
The Assistant Director of Agriculture (Field).
The Senior Agronomist.
The Principal, College of Agriculture, Malaya.
The Administrative Officer. **(Secretary).**

The Advisory Council, College of Agriculture, Malaya;

The Director of Agriculture, Federation of Malaya. **(Chairman).**
The Director, Rubber Research Institute of Malaya, Kuala Lumpur.
The Principal, Sultan Idris Training College, Tanjong Malim.
The Principal, College of Agriculture, Malaya.
The Director, Veterinary Services, Federation of Malaya.
The Hon'ble Enche Hashim bin Awang, J.P., Tassek Glugor.
Secretary of the Alumni Association, College of Agriculture, Malaya.
The Hon'ble Mr. Yap Kim Hock, Johore Bahru.
Datok Jaafar bin Mampak, Dato Wangsa, Kuala Trengganu.
Mr. Chan Hin Cheung, Kuala Lumpur.
Enche Jamaludin bin Aji, Seremban.
Enche Ismail bin Yusoff, Kuala Lumpur.
The Representative of the Rubber Producers' Council.
The Registrar and Bursar, College of Agriculture, Serdang **(Secretary).**

The Efficiency Bar Board:

The Deputy Director of Agriculture. **(Chairman).**
The Hon'ble State Secretary, Perak.
The Hon'ble State Secretary, Negri Sembilan.
The Representative of the Federal Government.
The Administrative Officer. **(Secretary).**

THE

Malayan Agricultural Journal

Vol. 40, No. 4, 1957.

EDITORIAL

One half of the earth's population lives in Asia and yet they receive only 11 per cent of the total income of the world. And among Asia's peoples, those living in the rural areas are the least well fed, clothed and housed. Malaya is no exception in that large numbers of her farmers live in poor conditions with little more accruing from their labours than daily sustenance.

By what means can rural conditions be improved? As elsewhere in Asia, Malaya's most important primary industry is agriculture and the way to rural improvement lies in increasing agricultural production. The two methods by which this can be achieved are to bring more new land under cultivation and to increase the yields on existing farmlands. The former is a promising prospect, but a long-term and expensive one; of much more immediate importance and practicality is the improvement of production on established agricultural lands. There are four main channels for increasing production:—soil conservation and improvement, including the more extensive use of fertilisers; provision of irrigation and drainage facilities where needed; the use of plant varieties which will give higher yields; and the better control of pests and diseases. Past efforts in these fields have given important progress but the potential for improvement is undoubtedly vast and continues to increase as new fertilisers, pesticides and fungicides and improved agricultural practices are developed.

The articles in this issue of the Journal record some of the work of the Drainage and Irrigation Department in providing better water control and of the Department of Agriculture in its agricultural research. An article on the Kedah Padi Planters Board describes the organisation of a powerful tool for alleviating rural distress, one which is designed to deal with the often unsatisfactory state of land rental and its associated problems. In addition there are short articles on two more of Malaya's "Master Farmers", men whose outstanding results prove that the use of improved agricultural methods is the key to reaping more from the land.

Correction

In Vol. 40, No. 3, page 206, it is stated that "Trioxone" is toxic to fish in quite low concentrations. We are now advised that this statement is incorrect: both its active ingredients, *2,4-D* and *2,4,5-T*, are virtually harmless to any species of fish found in Malaya when used at the proper concentrations for weed control.

THE SRI MENANTI, SENGGARANG AND MUAR DRAINAGE SCHEMES, JOHORE

BY

J. N. WILSON, B.Sc., M.I.C.E.,

Chief Design Engineer,

Drainage and Irrigation Department.

Introduction

As in most of the coastal areas in the Federation, the opening up of the west coast of Johore for coconut growing and for kampong * development was completely uncontrolled, and the land was developed with little or no thought for future drainage. The first colonists cleared narrow strips of land along the sea coast and dug drains which were adequate for the areas then served. But as each succeeding wave of colonists arrived and extended the clearing of land towards the foothills, they merely extended the drains without enlarging them. The result was a large irregular network of drains, which conformed to no general pattern for comprehensive drainage. In many cases, the only purpose served by the drains was to facilitate the entry of sea water onto the land, the actual reverse of what was intended.

In 1939 the Department of Agriculture reported that extensive areas of coconut small-holdings were steadily going out of cultivation owing to bad drainage and inundation by sea water. During the Pacific War conditions deteriorated, and over a large area coconuts were dying and yielding no fruit, thus depriving the kampong people in densely populated localities of their main source of livelihood.

Along the flat coastal plain, the exclusion of salt water and efficient drainage are the first requirements for successful agriculture. The Drainage and Irrigation Department has, therefore, prepared a comprehensive scheme to arrest deterioration and to restore satisfactory conditions for successful agriculture by the construction of coastal bunds, the provision of tidal control gates, the improvement of internal drainage and the alleviation of flooding from inland waters. The long-term objective is the completion of seventeen Drainage Schemes affecting nearly half a million acres, chiefly of existing small-holdings.

This paper will describe the Sri Menanti, Senggarang and Muar Drainage Schemes covering approximately 72,000 acres, the first three schemes to be completed.

Sri Menanti Drainage Scheme

GENERAL DESCRIPTION

The scheme covers an area of 26,244 acres of small-holdings, mainly planted with coconuts, lying astride the Batu-Pahat—Muar road, between the 91st and 101st mile posts (see Figure 1).

* kampong = village.

The original scheme, for which surveys were carried out in 1938, allowed for a coastal bund 14 miles long, five tidal control gates and the reconstruction of the internal drainage system. Accretion along the coast line and extensive opening up of the hinterland during the Japanese occupation necessitated reconsideration of the design after World War II. After further extensive surveys and investigations the scheme was amended in 1950. In brief, coastal accretion had reduced the discharge capacity of the tidal control gates and the opening up of the hinterland had produced a faster run-off. It was necessary to excavate a catch-drain, running approximately parallel to the coast and four miles inland, to drain the water from the hinterland into the Sungei Sarang Buaya through a main control gate at Parit Subari. The coastal tidal control gates would then be able to deal with the drainage of the reduced catchment areas.

Progress Prior to 1941

Work started in August, 1940, when a drag-line excavator commenced the construction of the bund at the road side, by the Sungei Sarang Buaya. The machine had reached Sungei Balang before the Japanese army arrived. The Balang gate had been completed and a start had been made on the Pulai gate. There was no progress on the scheme during the occupation.

Progress after 1945

Earthwork

During the early years after the war progress was extremely slow owing to the difficulties of obtaining mechanical plant. One excavator hired from the British army in October, 1947, completed the construction of 11 miles of coastal bund between the Balang Control gate and Parit Penyangat before it was returned, leaving three miles of bund to be completed in the coastal part of the scheme.

During this period, the Balang tidal control was reconditioned and three further controls were built.

Two new machines arrived in August, 1950, and February, 1951, and a further two in July, 1952. These machines were put to work on excavating the Subari catch-drain, described above, in order to give early relief from increased flooding in the area nearer the coast. The four machines worked steadily through 1952 and 1953, finally completing the drain in August, 1954. The spoil bank on the down-stream side of the drain has been levelled by bulldozer into a jeep track and will later be surfaced with laterite to provide an all-weather access road into the middle of the scheme.

Early in 1954 an excavator started the final stage of the coastal bund from the main road at Kampong Parit Jawa to Parit Penyangat. It completed the first dumping by September, 1954, and returned to the

road, making the final dumping in June, 1955. Thus, tidal water was finally cut off from the last part of the scheme.

The final major earth-work for the scheme was the widening and straightening of the Sungei Sarang Buaya between the end of the catch-drain and the sea. Flood levels along this reach indicated an unnecessarily steep gradient which adversely affected the discharge of the catch-drain. The straightening and widening was completed in December, 1956.

In 1951 the method of bund construction was altered to meet the extremely bad soil conditions in the area and the depredations of burrowing lobsters. From then on, the bund was made from material excavated from the landward side instead of the seaward side, as hitherto, by making two passes of the excavator, allowing an interval of two to three months between passes.

All coastal bunds are subject to attack by burrowing mud lobsters (*Thalassina anomala*). Although various chemical methods have been employed and are still used to control these pests, pre-war experiments indicated that their burrowing range was limited. For this reason the minimum base width of all coastal bunds has been specified as 30 feet; the mud lobster is fortunately unable to burrow for this distance. Up to 1950, it was the practice to build coastal bunds from external borrow pits, as experience had shown that these borrow pits silted up within a few years. However, this soft silt provided an ideal breeding place for the mud lobsters. Although the lobsters did not burrow through the bund, they climbed up the sides of the bund and over to the other side, making holes on both sides, preventing the establishment of a grass cover and generally making a mess of the area. After 1950 it was decided to build the bund by excavating an internal perimeter drain parallel to it and using the excavated material for the bund. This drain would help leach the salt out of the landward area more quickly, thus discouraging the breeding of mud lobsters which can live only in sea water. Although the success of this method of bund construction has not yet been proved, it has the added advantage of intercepting and collecting the discharge from old drains now cut off from the sea and leading it quickly to the nearest tidal control gate, thus generally improving the drainage potential of the system.

Tidal Controls

The Main Drainage Control at Parit Subari was scheduled for construction in 1951. Soil investigations to check the stability of the subsoil showed a stratum of running sand about six feet below ground level, which indicated that extreme difficulty would be experienced in keeping the sides of the excavation stable should the conventional method of construction *in situ* be used.

It was therefore decided to construct the control by the "flotation"

method. In this method, the main excavation is left full of water, while only a shallow construction paddock is dried out.

An excavation in soft coastal mud to a depth of six or seven feet below ground level is more or less stable if the banks are cut back to a slope of 1½ to 1 or 2 to 1. However, it is impossible to excavate to depths of 14 feet below ground level, the invert level of many tidal control gates, in the dry, unless the banks are cut back to slopes of 5 to 1 or even 6 to 1. This would necessitate a huge volume of excavation and would involve double and even treble handling of the spoil by excavator (bulldozers cannot work on such soft muds). The resultant construction pit would be unnecessarily large (say, 200 ft. x 270 ft. at ground level) and the work of back-filling the completed control, lengthy and costly. In the "flotation" method, the control is built on a high-level paddock only about six feet below ground level. This paddock can be de-watered safely and without fear of major bank slips. During the construction of the control, the final site is dug out under water by excavator to the correct depth of about 14 feet below ground level. As the pressure of the water prevents slips in the excavation, it is possible to cut the side slopes back to only 1½ to 1 or 2 to 1, which allows a reasonable sized paddock to be dug. Then, when the control is ready, the open ends are sealed off by wooden bulkheads and the construction and final site paddocks connected by a large drain. At a convenient time the whole area is flooded with water (generally making use of high tide), and this floats the control which is then towed by teams of men to its final site and scuttled into position by opening the bulkheads.

Previously, many small five feet square culverts had been built by this method, but the Subari Control, 123 feet long, 27 feet wide and weighing 540 tons without its superstructure and overbridge, was a much bigger proposition. However, the construction paddock was excavated and dried out without great difficulty. Concreting was started in September, 1952, and the first stage completed by the end of the year. The gate was floated and towed to its site before a crowd of spectators on 19th January, 1953, and was sunk into position successfully the next day. All work was completed and the control was in operation by June, 1953 (see Plate 1).

The contract for the last Tidal Control at Parit Jamil was let in 1954. Unseasonal rain held up the construction, which was again by the "flotation" method, so that the gate was not floated to its final position until 10th November. The concrete work was finished by the end of the year and the gate was put into operation in January, 1955.

A very wet monsoon period at the end of 1954 indicated that the capacity of the catch-drain at the end farthest from the main control was not sufficient to cope with very high flood discharges. It was therefore decided to construct a weir in the bank of the catch-drain which would discharge into Parit Jamil, the design of the Parit Jamil tidal control having allowed for this extra flow. This weir was completed

in May, 1956, while the deepening and widening of Parit Jamil itself between the tidal control and the weir were finished during the next month.

Access Bridges

There are numerous, old established footpaths running inland from the main road, which were cut across by the Subari catch-drain. As it was necessary to maintain these access routes, a type of footbridge or jeep bridge had to be designed which was permanent, safe, easy to maintain, and quick and cheap to construct. The design, evolved in the Batu Pahat Office, aimed at reducing the time of construction and labour charges to a minimum. It consisted of standard 17 ft. or 12 ft. span reinforced concrete beams, supported on piles made up from standard pre-cast concrete pipes, the pipes being joined by internal reinforced concrete splices to produce the necessary length of piles. Specially made timber forms for the capping beams and for the main beams were supplied by the Drainage and Irrigation Department to the contractor. The decking for the bridges, 6 ft. wide, was of hard-wood. After the normal teething troubles, the local contractors became very adept at building these bridges, and during 1956 were making bridges of 102 ft. span five miles in from the main road, by drain, at an all-in cost of $18 per foot. The cost of the 32 bridges built (totalling 1,541 feet) was $24,382, or an average for the scheme of $15.82 per foot. It is interesting to note that the success of these bridges was observed by a prominent pre-cast concrete manufacturing firm in Singapore, who quickly adopted the design to suit their own pre-stressed units.

Final Costs and Completion Dates

Although there is still, in 1957, a little work to be done in desilting some of the older drains, the scheme has been virtually completed.

The final cost of the scheme is estimated at $1,519,200 or $57.90 per acre.

Drainage Rates

The area was finally gazetted as a Drainage Area in December, 1956, under the Drainage Works Ordinance No. 1 of 1954. Allowing for a normal 3 per cent interest on the capital cost, a 2 per cent repayment of capital and an annual maintenance cost of $120,000, the annual drainage rate would be $7.50 per acre. The Johore Government have ruled that a drainage rate to recover the maintenance cost only should be imposed at the present time, and have gazetted a rate of $4 per acre for 1957.

Success of the Scheme

Drainage

The rainfall during the 1956-57 monsoon was unusually light; thus it was not possible to test the final scheme under conditions that

would previously have caused serious flooding. However, in January, 1956, when the rainfall was very heavy and when many parts of Johore were seriously flooded, no part of the area was flooded.

Agriculture

It is not yet possible to assess the agricultural success of the scheme, though the State Agricultural Officer reports that the beneficial effects of drainage at the Sungei Sudah Agricultural Station are apparent now in the improved appearance of the coconut palms and the better structure of the soil.

The local small-holder obviously appreciates the scheme, as can be seen from the following prices of land within the area, in free sales, as against Government acquisition:

1948	....	$250 per acre.
1952	....	$250 to $400 per acre.
1956	....	$250 to $600 per acre.

Senggarang Drainage Scheme

General Description

The Senggarang Drainage Scheme is situated in the low-lying coastal flats between Senggarang village and the Sembrong River (see Figure 2 and Plates 2 and 3). Frequent and disastrous floods have occurred here in the past, due to high water from the Sembrong River entering the area and tidal inundation of the coastal strip.

To find ways and means of alleviating this flooding a comprehensive survey of the area was carried out between 1936 and 1938. The drainage scheme prepared in the following year allowed for the construction of a flood protection bund, 11 miles long, on the left bank of the Sungei Sembrong, 17½ miles of main drainage channel, two main drainage controls and the deepening and widening of certain secondary channels within the area. The original estimated cost was $270,000.

Progress Prior to 1941

In October, 1939, an excavator started work on the construction of the flood protection bund. In contrast to the coastal section the soil here was good and little difficulty was experienced. The excavator continued to work until the outbreak of war, when 80 per cent of the bund was complete. Another excavator started on the Senggarang main drain in July, 1939, and worked until October, 1940, when it was transferred to another job.

The construction of the Senggarang tidal control gate was started in January, 1940. This gate is the largest of its type in Johore; the tower rises 40 feet above ground level, supporting a steel gate 13 feet

deep, with a span of 30 feet. The control was completed and commissioned in November, 1940.

Progress from 1945 to 1948

The whole area presented a derelict appearance in September, 1945. The maintenance of bunds, drains and the gate had been completely neglected, and in the case of the latter, had resulted in serious damage to the steel work. The excavator was found in need of extensive repairs and had to be dismantled and sent away for a complete overhaul.

As in other areas, the lack of mechanical plant held up progress of the scheme in 1946 and 1947. By 1948 three excavators were allocated to the area, and the Sembrong bund with its tidal control gate was complete. A start had also been made on drain No. 5.

Flooding from 1948 to 1952

It became evident, after the bad flood of December, 1948, that the scheme was not functioning in accordance with the original design. After detailed investigations of conditions, it was decided to increase the discharge capacity of main drains Nos. 1 and 3, to extend main drain No. 5 and to canalize the tortuous length of the Senggarang outlet, below the main road bridge, as an interim measure pending further investigations and discharge measurements.

Heavy flooding occurred again in 1951 and 1952, affecting chiefly the northern parts of the area. In 1951 parts of Sembrong Estate were under water for 30 days, the Sri Paya swamp, where the land is below high tide level, was flooded for two months, while Senggarang village was inundated for 13 days. Conditions had improved by 1952 as only Sembrong Estate and the Sri Paya area suffered flooding for 20 days and Senggarang village was unaffected.

Final Design

The results of these two floods provided sufficient data to complete the final design of the scheme. This data showed that owing to the extreme flatness of the area, no drainage system could possibly cope with the run-off of the 34 square miles of high land of the catchment area.

It was therefore decided to excavate a drain of large section, 15 miles long, called the Botak high level drain, situated between the 17½ mile post on the Batu-Pahat—Ayer-Hitam road and the 16½ mile post on the Batu-Pahat—Pontian road. The object of this drain was to remove separately the run-off from land well above tidal influence. This run-off would discharge freely into the sea, without the use of tidal control gates. Earth bunds would be used on either side of the drain in its lower reaches to prevent its flood flow from inundating the low lying land below its catchment.

The route finally selected for the outfall of the Botak high level drain is situated to the south-east of the original boundary of the Seng-

garang Drainage Scheme. The new boundary thus formed left a roughly triangular portion of land, about 10,000 acres in extent, between it and the former boundary. This area of coconut and rubber smallholdings has been incorporated in the Senggarang Drainage Scheme and is known as the Senggarang Drainage Scheme Extension.

The final design of the whole scheme embraces 26 miles of main and subsidiary drains, 3 main and 4 minor drainage controls, 11 miles of river bund, 3½ miles of coastal bund and the reconditioning of about 34 miles of kampong drains.

PROGRESS AFTER 1948

Earthwork

The widening and deepening of main drains Nos. 1 and 3 and the extension of main drain No. 5 were completed in 1952, while the canalization of the Senggarang outlet was finished early in 1953.

Two excavators then started on the excavation of the Botak high level drain, at the sea coast end, where the drain is 120 feet wide. A further four machines were put on this job between July and November, 1953. The drain was finally completed in December, 1956, after 1,800,000 cubic yards of earth had been dug. The right bank bund has been graded to form a road, which the Public Works Department are now surfacing. This road will not only be of strategic importance, but will also be of great local value as it will help in the development of an area which now lacks proper access.

As other works were finished it was possible to allocate further excavators to the Senggarang Scheme. Thus two machines started on the Hylam main drain in December, 1954. A further two machines were added in March and December, 1955, and the drain was finished in March, 1956. All four excavators then moved on the excavation of the compartment drains and the improvement to existing kampong drains, completing the job in December, 1956.

Structures

The main drainage control at Hylam and the two compartment controls on the coast were constructed in late 1953 and early 1954 by the "flotation" method, as described in the section on the Sri Menanti Drainage Scheme. The Hylam main control (see Plate 4), weighing about 500 tons, was built near its final site and was floated and sunk into position without trouble in February, 1954.

As the sites for most tidal controls are situated at inaccessible places along the sea coast, all construction materials have to be transported by small boats from the road-side along small drains. Naturally such difficulties of access increase contract prices. For the construction of the two compartment controls, a site was chosen at Senggarang village, where the Contractor had lorry access to the work. The first control,

weighing about 70 tons, was completed at Senggarang in 1954 (see Plates 5 and 6). On the night of 20th April, it was floated into the Senggarang river and towed by launches three miles down to the mouth of the river, where it was anchored for the night. Early next morning, it was towed out to sea, along the coast for a further 2½ miles and then up Parit Hylam to its final site, where it was successfully sunk into position. The second control, weighing 175 tons, followed the same route without any trouble in July, 1954.

These operations showed a visible saving of 4 per cent on previous costs and ensured better supervision of the work. In addition, there was a large invisible saving, as officers were able to reach the site of the work quickly, instead of wasting an hour each way on getting to and from the job.

The steel gate of the Senggarang main drainage control, built in 1940, had shown signs of deterioration after the Japanese occupation and had been patched up in 1946; by 1954 it was obvious that the gate would not last much longer. A new gate fabricated by the Public Works Department's Federal Workshops was fitted. This work necessitated the construction of two coffer-dams, 30 feet wide, to withstand a head of water 12 feet deep, the cutting out of the old gate by oxy-acetylene blowpipes, and the manoeuvring into position of the new gate, 13 feet high with a span of 30 feet and weighing 13½ tons. After a certain amount of trouble the job was completed in December, 1954. Cathodic protection was applied to the gate in 1955, which, it is hoped, will ensure a longer life.

The final structures, the two compartment drainage controls at the top end of the Hylam main drain, were started in May, 1956, and completed in September, 1956.

Access Bridges

In November and December, 1953, the first pre-stressed bridge to be built in Malaya was constructed across main drain No. 5. It has a total span of 75 feet, with a removable span of 15 feet in the centre to allow a dredger to pass. The experience gained during the construction of this bridge has shown that pre-stressed concrete work can be undertaken with the labour available, but that extra supervision is required. The rest of the bridges built in the area are of the D.I.D. type evolved for the Sri Menanti Scheme. There are 36 bridges in the Senggarang Drainage Scheme area with spans varying from 36 to 109 ft. and totalling 1,622 ft. The cost of these bridges was $23,315.50 or an average of $14.37 per foot run. Similarly over the Botak high level drain 26 bridges totalling 2,301 ft. were built for $36,435.25 or an average of $15.83 per foot run.

Final Costs

The scheme was completed in 1956 at a total cost of $1,597,000. The Land Office has not yet calculated the actual area of land protected,

but it is estimated at 36,000 acres; thus the cost works out at $44.36 per acre.

The cost of the Botak high level drain, which is not charged to the scheme, was $1,284,000.

DRAINAGE RATES

The first part of the scheme was gazetted as a Drainage Area in December, 1955, and the extension area will be gazetted during 1957.

No drainage rate is to be imposed in 1957.

SUCCESS OF THE SCHEME

Drainage

As in the Sri Menanti Scheme, the unusually light rainfall during the 1956 monsoon did not test the drainage system.

The heavy rainfall in January, 1956, rainfall which previously would have seriously flooded large areas of the scheme, affected only the Sri Paya swamp area for two or three days, while elsewhere the usual flooding was prevented. There is reason to believe that the drainage system provided will now be adequate.

Agriculture

It is still too early to assess the agricultural success of the scheme, though the State Agricultural Officer reports that the average yield within the scheme is 5.5 piculs of copra per acre per annum, as against an average of 4.33 piculs for the whole of Johore. Even this minor increase in yield at present day prices ($23.00 per pikul) would pay for the capital cost in two years.

One of the more obvious benefits of the scheme is the increase in size of Senggarang village, where many old shop houses built of timber have been replaced by brick buildings and where many new brick houses are being built. There is also the flourishing weekly market at Parit Raja village, attended by many people from Batu Pahat and even farther afield, where the smallholders sell their produce. In both these villages, local contractors licensed by the Central Electricity Board have installed electric lighting plants, which appear to serve most houses in the vicinity.

Finally, the following figures of the prices of land, in free sale, as against Government acquisition, show the value placed by the local people on the scheme:—

1948	....	$ 50 to $150 per acre
1952	....	$150 to $250 per acre
1956	....	$250 to $400 per acre.

Muar Drainage Scheme, Stage I

GENERAL DESCRIPTION

This scheme lies to the north-east of Muar town, contiguous to the Town Board boundary, with the Muar river forming its north and

west boundaries and high ground the southern boundary (see Figure 3). It covers an area of 9,084 acres, consisting of 80 per cent rubber, 10 per cent coconut and 10 per cent vegetable small-holdings.

There have been numerous complaints of flooding in the area since 1946. Investigations showed that many areas were flooded regularly to depths of 18 inches after comparatively light rainfall. The cause of the flooding was the increased run-off and inadequate drainage due to the neglect of the existing drains and natural outlets over a period of years and also to the increased opening up of new land.

The scheme, prepared in 1953, is in two stages; Stage I covers the catchment areas of the Sungei Terap and Sungei Abong while Stage II deals with the Sungei Raya and Sungei Merbudu. Agricultural drainage will be diverted from the Town Council area of Muar Town. The land within the catchment of Stage II is higher than that of Stage I and is less in need of urgent drainage improvements. No drainage controls are necessary as the land is generally above high spring tide level.

The main work was the straightening, deepening and widening of four miles of the Sungei Terap, the natural outlet for the area, and the widening of three road bridges. In addition, the drains from the Sungei Abong catchment, which flowed into Muar town and caused flooding, were diverted into the improved Sungei Terap channel. Finally many of the minor drains were to be deepened and regraded as and where necessary.

Progress

An excavator started work on the Sungei Terap in August, 1954, and was joined by a second machine in January, 1955. These machines completed their work on this river in March, 1956, and then moved down to Parit Rambai, finishing the deepening and widening of that drain in November, 1956.

In the meanwhile the work of regrading the minor drains by hand labour was started in March, 1955. Most of this work has now been completed, though a little tidying up remains to be done.

Final Costs

The estimated final cost of the scheme, exclusive of the bridges, is $257,000 or approximately $28.30 per acre.

Drainage Rates

The area will be gazetted as a Drainage Area during 1957.

No drainage rate will be imposed in 1957.

Success of the Scheme

Drainage

The unusually light monsoon of 1956 did not produce a great enough run-off to test the efficiency of the drainage system. The heavy

rainfall in January, 1956, did, however, demonstrate the improved capacity of the Sungei Terap, for although the river was flowing to berm level for two days no flooding occurred.

Agriculture

It will not be possible to assess the agricultural success of the scheme for two or three years. The local farmers are evidently aware of the benefits as they are now pressing for the construction of Stage II. In addition the following figures of land sales indicate the value placed on the scheme.

1948	....	$150 to $250 per acre
1952	....	$200 to $250 per acre.
1956	....	$200 to $300 per acre.

Figure 1

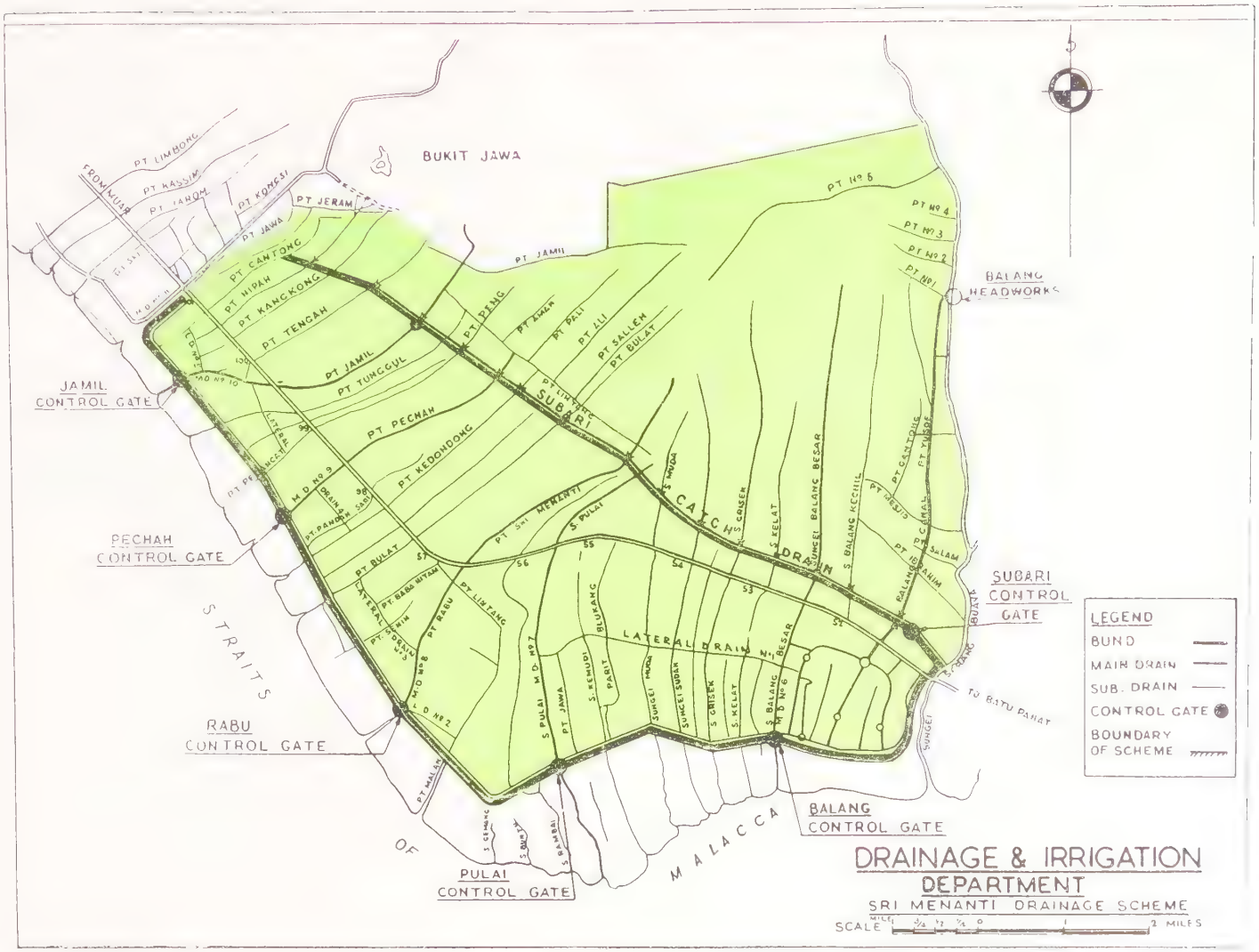

BUKIT JAWA
PT JERAM
PT JAWA
PT CANTONG
PT HIPAH
PT KANGKONG
PT TENGAH
PT JAMIL
PT TUNGGUL
PT PECHAH
PT KEDONDONG
PT PAHANG
PT BULAT
PT BABA HITAM
PT LIMTANG
PT JAMIL
PT PENG
PT ASSEN
PT PALI
PT ALI
PT SALLEH
PT BULAT
PT No 6
PT No 4
PT No 3
PT No 2
PT No 1
BALANG HEADWORKS
JAMIL CONTROL GATE
PECHAH CONTROL GATE
RABU CONTROL GATE
PULAI CONTROL GATE
BALANG CONTROL GATE
SUBARI CONTROL GATE
SUBARI
CATCH DRAIN
LATERAL DRAIN No 1
LATERAL DRAIN No 2
S. PULAI
S. KELAT
S. BALANG BESAR
S. BALANG KECHIL
S. KEMUDI
S. GRISEK
S. SUDAH
S. MUDA
PT IBRAHIM
PT SALAM
PT CANTRUS
PT TUNSOF
PT GRESTA
PT CHEMAL
PT MALEK
PT SAI MERANTI
TO BATU PAHAT
STRAITS OF MALACCA
LEGEND
BUND
MAIN DRAIN
SUB. DRAIN
CONTROL GATE
BOUNDARY OF SCHEME
DRAINAGE & IRRIGATION DEPARTMENT
SRI MENANTI DRAINAGE SCHEME
SCALE
MILES
2 MILES

Figure 2

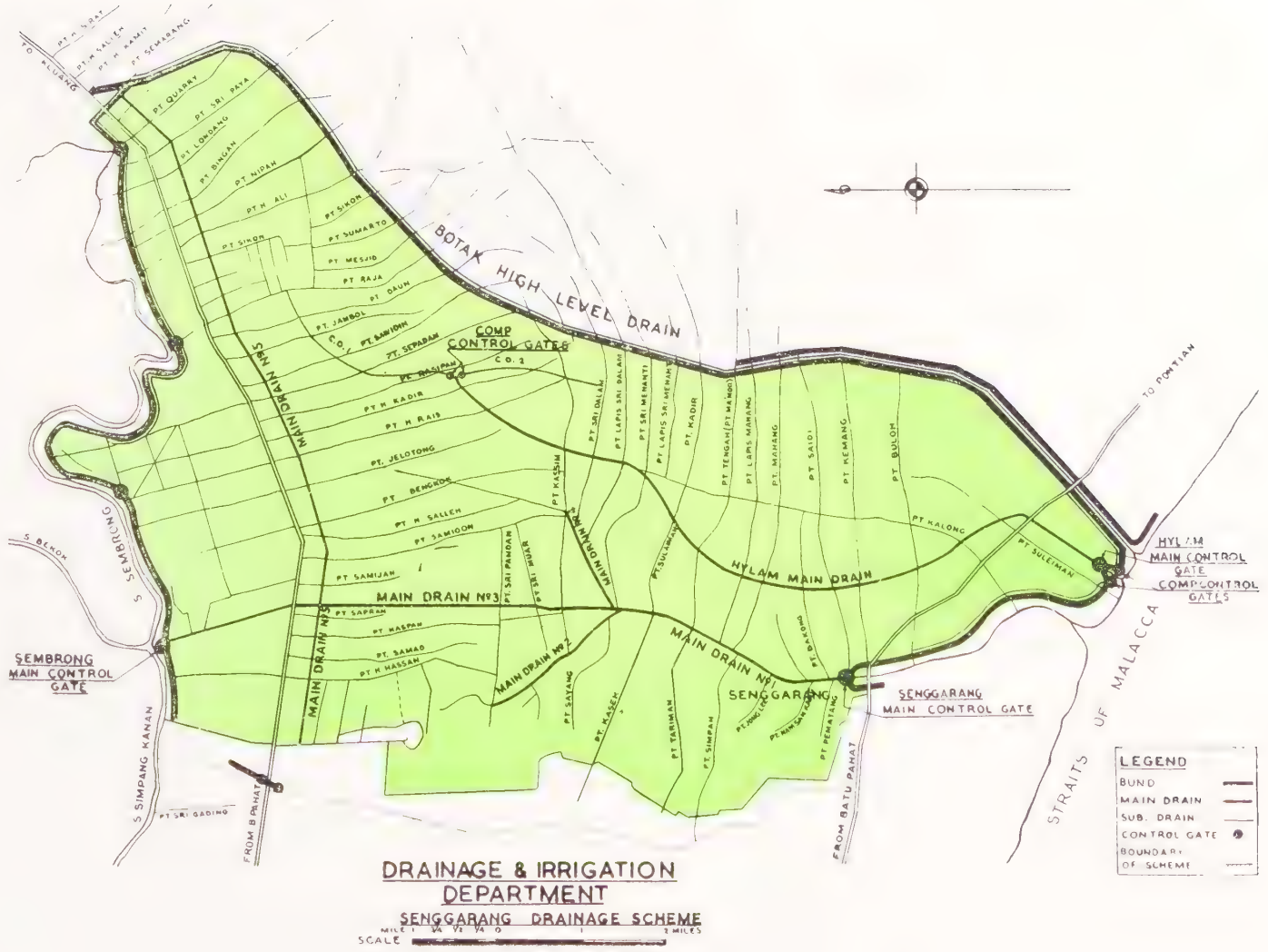

BOTAK HIGH LEVEL DRAIN
COMP CONTROL GATES
CO. 2
MAIN DRAIN No 3
MAIN DRAIN No 2
MAIN DRAIN No 1
HYLAM MAIN DRAIN
HYLAM MAIN CONTROL GATE
COMP CONTROL GATES
SEMBRONG MAIN CONTROL GATE
SENGGARANG MAIN CONTROL GATE
S. SEMBRONG
S. BENOK
S. SIMPANG KANAN
TO KLUANG
TO PONTIAN
FROM BATU PAHAT
FROM B PAHAT
STRAITS OF MALACCA
LEGEND
BUND
MAIN DRAIN
SUB. DRAIN
CONTROL GATE
BOUNDARY OF SCHEME
DRAINAGE & IRRIGATION DEPARTMENT
SENGGARANG DRAINAGE SCHEME
SCALE
MILE 1 3/4 1/2 1/4 0 1 2 MILES

Figure 3

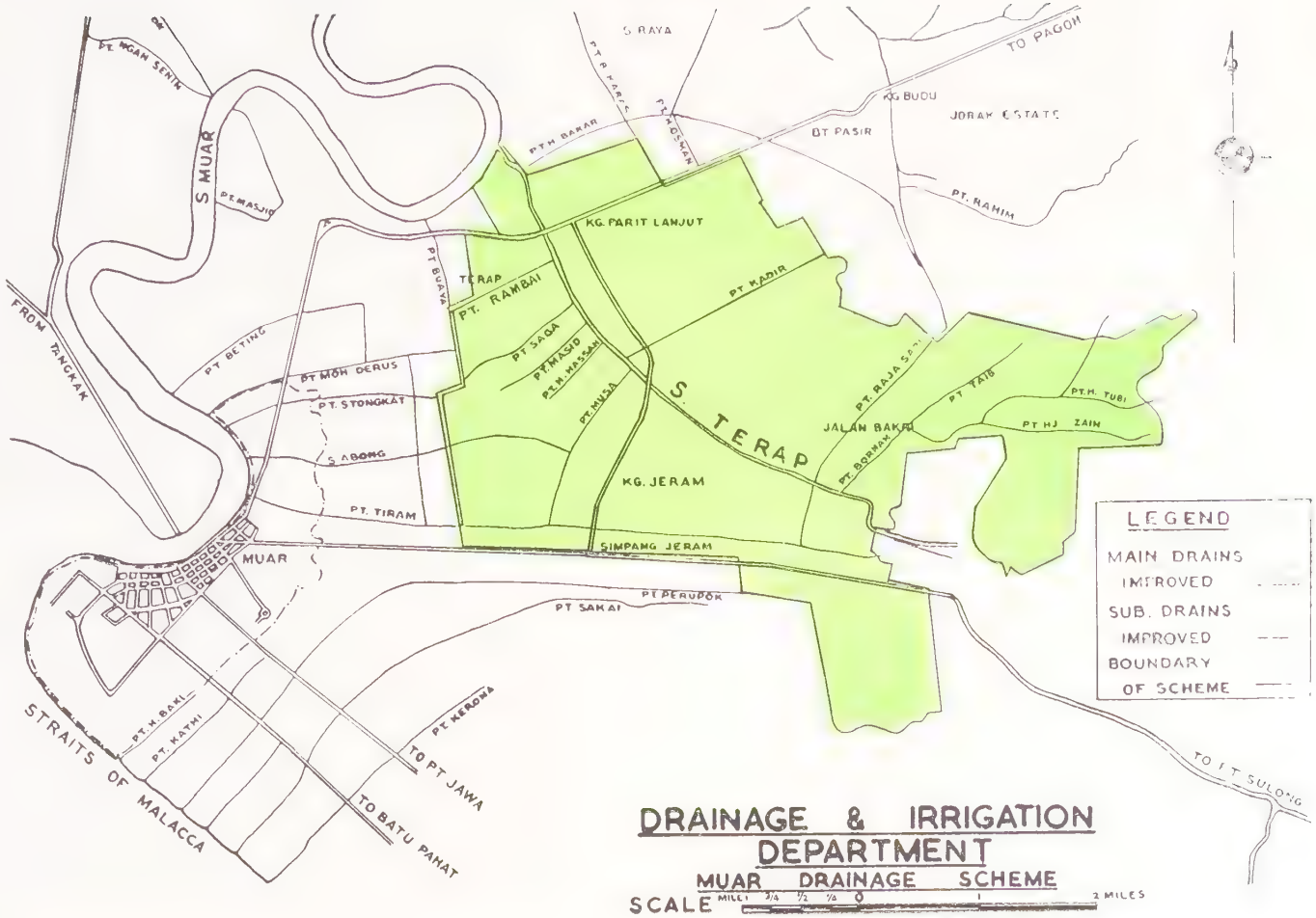
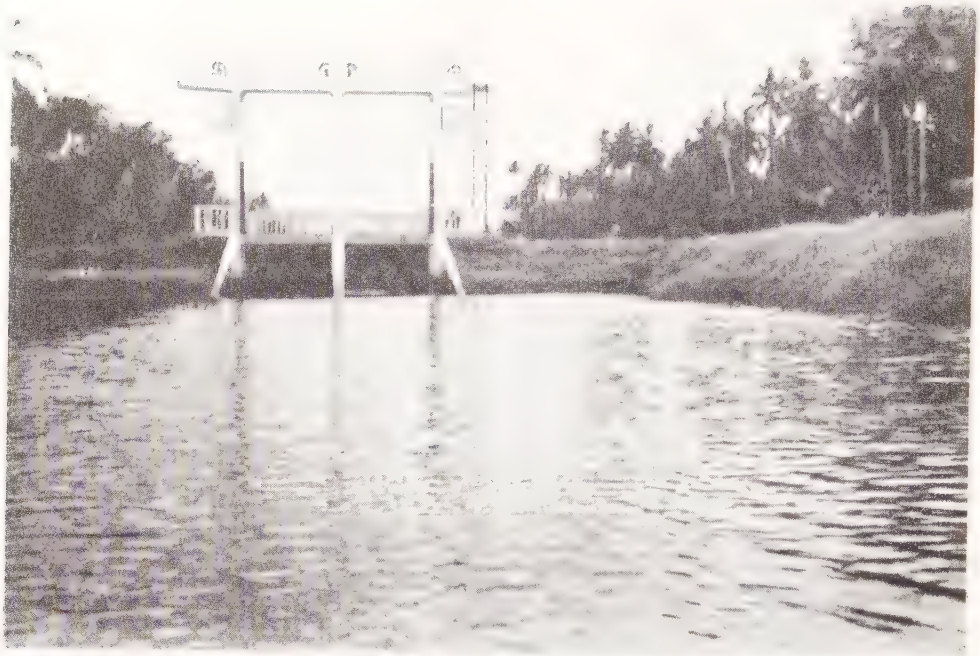

S RAYA
TO PAGOH
KG BUDU
JORAK ESTATE
PT PASIR
PT RAHIM
PT H BAKAR
PT MASJID
S MUAR
KG PARIT LANJUT
PT KADIR
PT BUAYA
PT RAMBAI
PT SAGA
PT MASJID
PT M MASSAH
PT MUSA
S TERAP
PT RAJA SPD
PT YATIB
PT H TUBI
PT HJ ZAIN
JALAN BAKRI
PT BORHAN
KG JERAM
PT MOH DERUS
PT STONGKAT
S ABONG
PT TIRAM
PT BETING
FROM PENGKAK
MUAR
SIMPANG JERAM
PT PERUBOK
PT SAKAI
PT M BAKI
PT KATHI
PT KERONA
TO PT JAWA
TO BATU PAHAT
STRAITS OF MALACCA
TO P T SULONG
LEGEND
MAIN DRAINS IMPROVED
SUB. DRAINS IMPROVED
BOUNDARY OF SCHEME
DRAINAGE & IRRIGATION DEPARTMENT
MUAR DRAINAGE SCHEME
SCALE
MILES
2 MILES

PLATE 1



The Parit Subari control gate.

PLATE 2

The Senggarang drainage area.

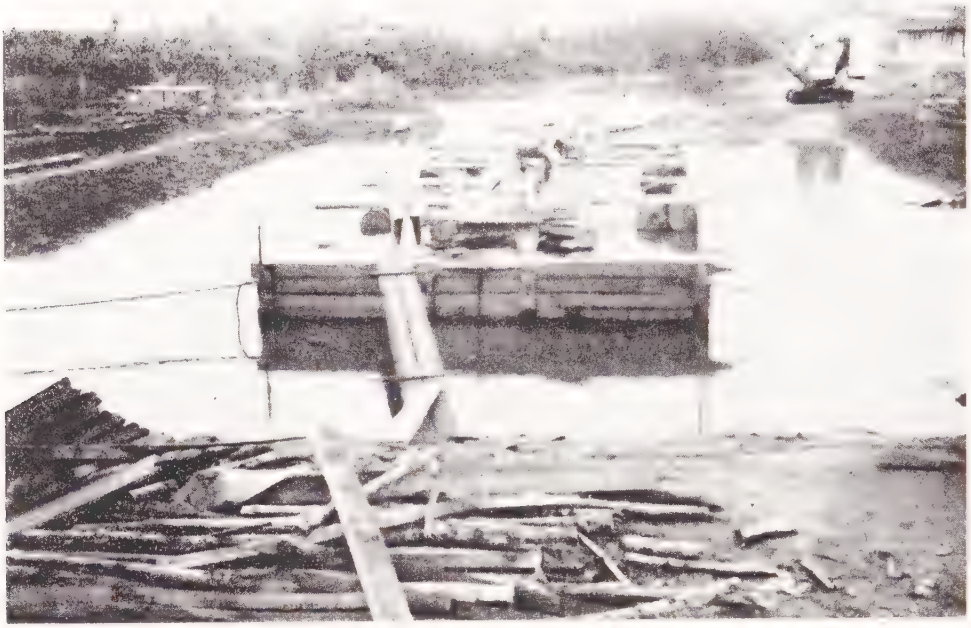
PLATE 3

A view across the Senggarang drainage area from Parit Bahru in September, 1954

PLATE 4

The Senggarang main control gate.

PLATE 5



The Senggarang compartment control floating in the paddock near the roadside.

PLATE 6

The Senggarang compartment control approaching Parit Hylam from the sea.

PINEAPPLE FRUIT COLLAPSE

BY

ANTHONY JOHNSTON,

Senior Plant Pathologist.

Introduction

Fruit collapse is the name given by Thompson to a disease of the pineapple first discovered in December, 1935 (5). In the first published report of the disease, which appeared in 1937 (4), it was stated that "the disease appears very suddenly, so that a ripening fruit which is apparently firm and healthy will become soft and collapsed within 24 hours..... The fruit is of a dull green colour externally, and internally the flesh is of a characteristic homogeneous, pallid-yellow colour, and is soft and disintegrating and has a distinctive smell." No published record from any other part of the world of a disease definitely showing these symptoms has been found. As noted by Thompson (5) the fruit fermentation disease described by Sideris and Waldron (3) showed some resemblance and more recently Oxenham (2) has described from Queensland a disease called yeasty rot, the symptoms of which are also somewhat similar. In both cases, however, yeasts are reported as being the cause of the disease which, as shown below, is not true of fruit collapse. It would appear, therefore, that this disease occurs only in Malaya.

Since the disease was discovered several attempts to find out its cause have been made. In 1937 Thompson (5) reported that isolations of two species of bacteria, yeasts and a species of *Fusarium* had been made from affected tissues but that the disease could not be reproduced by the introduction of these organisms into healthy fruits; nor was the disease induced by introducing pieces of affected fruits into healthy fruits. Further unsuccessful attempts to discover the cause of the disease were recorded in 1939 (6) and 1940 (7). In 1949 the disease was reproduced by wounding healthy fruits and inoculating them with disease material (8). This gave a strong indication of the parasitic nature of the disease but again introduction into healthy fruits of pure cultures of bacteria and yeasts isolated from affected fruits gave negative results.

Investigations reopened by the present author at the end of 1954 proved that the disease is caused by a bacterium. The results of this more recent work are given below.

The name fruit collapse, although first used to describe the disease about 20 years ago, is still not in general use. The name ghost fruit is sometimes used but the disease is most commonly known as fruit rot. The original name is retained here in preference to fruit rot, as not only does it give a better description of the disease but it is also more specific, disinguishing this type of rotting from the various other types of fruit rot which occasionally occur.

Except where otherwise mentioned, all observations and experiments were carried out on the variety Singapore Spanish, that being the only variety commercially grown on a large scale in Malaya.

Occurrence and Economic Importance

Fruit collapse was first discovered in Johore in 1935 and all early reports came from that State (5). It was not until April, 1956, that the disease was definitely recorded from another State, when it was confirmed as being present in the south of Perak. It is not yet known to occur in any other part of Malaya.

In Perak the disease has so far caused negligible losses. In Johore, estimates of losses of fruit due to the disease vary but have at times been as high as 40 per cent. In two experiments (J.P.3 and J.P.20) carried out on an estate in the Pontian area between 1951 and 1955 and for which detailed records of fruit-collapse incidence are available, monthly losses varied from nothing to 58 per cent, with an average loss over the whole period of just over 17 per cent. Figures for fruit-collapse incidence in 11 agronomic and other experiments carried out in the Pontian area of Johore between 1951 and 1956 are given in Table I.

Table I

Incidence of Fruit Collapse in the Pontian Area of Johore.

Experiment Number	Recording Period	Total Number of Fruits	Fruits Affected by Fruit Collapse	Percentage Collapsed Fruits
JP 3	June '51 to June '55	1,717	376	21.9
JP 5	July '51 to December '52	4,576	559 *	12.2
JP 6	October '53 to May '55	21,629	1,027 *	4.7
JP 7	October '53 to June '55	25,310	1,081 *	4.3
JP 9	September '53 to June '55	35,887	884 *	2.5
JP 17	March '54 to June '55	11,270	625 *	5.5
JP 18	May '53 to January '54	9,095	417 *	4.6
JP 20	July '52 to June '55	999	95	9.5
JP 21	March '55 to April '55	5,666	895 *	15.8
J 154	September '55 to December '55	1,360	307	22.6
J 168	April '56 to December '56	4,760	348	7.3

* These figures may include some fruits affected by rot caused by over-ripeness, animal damage, etc.

These figures indicate the rather wide variation in fruit-collapse incidence which can occur but the mean figure of 10.0 per cent for the 11 experiments is probably a fair estimate of losses incurred on large estates during the past few years.

Symptoms

The name fruit collapse aptly describes this disease. A seemingly healthy fruit, just before it is due to become orange and ripen, develops into a soft, oozing mass of rotten tissue, held together by the somewhat firmer skin. This rotting appears to occur overnight.

Externally the skin of an affected fruit is of a dark, dirty, olive-green colour, while the bracts of the fruitlets are dull yellow. The outermost tissues, although discoloured, are not at first much affected by the rot so that the fruit retains its shape for some time, although

it is quite soft and can easily be pulled to pieces. Ultimately the tissues become so disintegrated that the fruit collapses under its own weight.

Internally the diseased flesh is of a dull, greenish-yellow colour. At first it is moist and only distinguishable from healthy flesh by its colour. Later, however, the soft tissues become liquefied and, escaping as juice, leave behind only the dry, fibrous tissues. This disintegration and escape of juice results in the formation in the diseased fruit of numerous air spaces (Plate IV).

The copious exudation of juice is one of the most striking features of fruit collapse. In the fruits in which this factor was examined, the average amount of juice lost was 281 ml. (almost 10 fl. oz.), representing a loss in weight of 34 per cent. The largest amount of juice produced by a single fruit was 417 ml. (14 2/3 fl. oz.) a loss in weight of 42 per cent. During the breakdown of the tissues there is also produced a considerable quantity of gas, the escape of which through crevices in the surface of the fruit can be distinctly heard.

Diseased fruits have a characteristically sharp, acid smell.

From the time of infection the disease develops very rapidly. This, combined with the fact that during the early stages of the disease there are no external symptoms, makes it difficult to study the progress of natural infections. Because of this difficulty the development of the disease as described below was studied in fruits artificially infected in the laboratory or in the field.

One day after infection takes place there is no external sign of rotting but internally a small area round the point of entry of the causal organism can be seen to be affected. Diseased tissues at this time are still firm but have a dull, water-soaked appearance. About one per cent of the volume of the fruit is then affected.

Two days after infection there is still no external sign of disease, although the area round the point of infection is slightly softened. Internally the rotted area extends to the core, up to about ten per cent of the volume of the fruit being affected (Plate I). There is still little sign of liquefaction of the tissues and no juice escapes at this stage.

After three days exudation of juice from the inoculation point begins and at this time the skin of the fruitlets surrounding the point of infection assumes the dull greenish colour which is characteristic of the disease. The discoloured area is soft and can easily be depressed, when a little juice is expressed. Internally the rotted area extends well beyond the core of the fruit and involves about 40 per cent of the flesh (Plate II). Despite this extensive rotting only a small quantity of juice is exuded.

During the fourth day rotting and liquefaction of the tissues proceed rapidly; at this time of maximum activity, up to 16 ml. of juice per hour may be exuded by a medium-sized fruit. By this time the fruit is olive-green and soft over most of its surface and juice can be seen emerging not only at the point of infection but also from between the fruitlets over a large part of the fruit's surface. Internally the whole

of the fruit except a narrow area at the top and bottom is rotted, about 80 per cent of the fruit being affected (Plate III). Air spaces are now beginning to form in the flesh.

Rapid rotting and exudation of juice continue during the fifth day, by which time all the flesh of the fruit is affected and the typical symptoms of fruit collapse, as shown in Plate IV, are attained. During the sixth day exudation gradually stops and the action is complete except that the rot may continue to spread for two or three inches down the stem. If left on the plant the fruit gradually collapses under its own weight and falls to the ground.

The Causal Organism

Isolation

Microscopic examination of the internal tissues of fruits affected by fruit collapse revealed in all cases the presence of large numbers of motile bacteria in the rotted tissues. It appeared likely that these bacteria might be the cause of the disease; isolations were therefore made from fruits in which the advancing edge of the rot was still distinguishable and which were thus known to be in a fairly early stage of the disease. These isolations were carried out by making a dilute suspension of the bacteria in sterile distilled water and streaking this suspension on to plates of beef-extract—peptone agar. From these plates pure cultures of several different species of bacteria were obtained and maintained in beef-extract—peptone—glycerine broth. These isolates were tested for pathogenicity by inoculating them into healthy fruits and those cultures causing fruit-collapse symptoms were retained for further study.

Proof of Pathogenicity

Laboratory inoculations were performed on fruits collected from the Federal Experiment Station, Jalan Kebun, Selangor. Inoculation was carried out as soon as possible after collection of the fruits. The inoculation technique used was either to place a drop of a bacterial suspension on the surface of the fruit and prick through it with a sterile needle or to make a hole in the fruit with a small, sterile cork borer and introduce into the hole a few drops of bacterial suspension. In either case the point of inoculation was then kept moist with wet cotton wool covered with a square of polythene sheeting held in place by rubber bands. The whole fruit was then enclosed in a polythene bag to maintain a high humidity. Fruits were for convenience usually inoculated about half-way up the side but equally good results were obtained by inoculation at any other point on their surface.

Proof of pathogenicity was obtained in numerous infection tests. For example, in one test of an isolate from South Perak, 12 fruits were inoculated, while 12 fruits, treated similarly except that sterile distilled water was used in place of the bacterial suspension, were used as checks.

PLATE I

Affected fruit in an early stage of the disease (two days after infection).

PLATE II

Diseased fruit three days after infection. Liquefaction of the tissues just beginning.

PLATE III

Diseased fruit four days after infection. At this stage rapid exudation of juice begins.

PLATE IV

Diseased fruit six days after infection. The fruit is now completely rotten.

Within a week all the inoculated fruits had become affected by fruit collapse whereas the check fruits remained healthy.

In another experiment the same technique was used but the inoculations were performed on plants growing in the field. This was done to discover whether results obtained with cut fruit in the laboratory could be duplicated under more natural conditions. Nine fruits were inoculated with a suspension of bacteria and three uninoculated fruits were kept as checks. All the inoculated fruits developed typical symptoms of the disease within a week whereas the check fruits remained healthy.

Re-isolations were made from inoculated fruits and the original bacterium was recovered.

Identity

Ten vigorously pathogenic bacterial isolates, eight from Johore and two from South Perak, were selected for investigation.

All tests carried out proved that these isolates were identical, indicating that fruit collapse is always caused by the same single species of bacterium.

It also soon became apparent that this bacterium closely resembled the bacterium which causes heart rot, a disease of young pineapple plants which was also under investigation and which has been described in an earlier paper (1). An extensive series of tests confirmed that the morphological, physiological and cultural characteristics of the fruit-collapse bacterium were the same as those of the heart-rot bacterium.

Further confirmation that the heart-rot and fruit-collapse bacteria are identical was obtained from cross-infection experiments. Young pineapple plants were artificially infected with the bacteria causing fruit collapse, resulting in the development of typical heart-rot symptoms. Similarly, bacteria isolated from plants affected by heart rot were found capable of causing fruit collapse when inoculated into healthy fruits. Symptoms thus produced were indistinguishable from those caused by the bacterium isolated from affected fruit or from those shown by natural infections in the field.

The bacterium causing heart rot has been described in a previous paper (1) and has been identified as a strain of the common soft-rotting organism *Erwinia carotovora* (Jones) Holland. As shown above, this strain of *E. carotovora* is also the cause of fruit collapse.

Factors Affecting Susceptibility

Age of Fruit

Under natural conditions the disease appears on fruits just before they are ready for harvest. More detailed information on the susceptible period was obtained by artificially inoculating fruits of different ages. By this means it was found that typical symptoms could be induced on fruits due to ripen in about eight weeks' time but not on younger fruits. Susceptibility increased during the following four to five weeks and remained at a maximum during the last few weeks before ripening. By

the time fruits were beginning to turn orange they had developed considerable resistance to infection and in several of the fruits used in these experiments fruit collapse could not be induced or, if it did occur, affected only part of the fruit.

Age of Plant

In recent years fruit collapse has been most prevalent on newly opened-up areas, whereas on old-established plantings which had not been replanted for many years the disease was of negligible importance. This indicated that the susceptibility of the fruit might depend on the age of the plant on which it grew. To obtain further information on this point a survey of small-holdings and estates in the Pontian area of Johore was carried out in November and December, 1955. A summary of the results of this survey in which about 230,000 fruits from 32 sites were examined is given in Table II.

Table II

Effect of Age of Plant on Fruit Collapse Incidence

Year of Planting	Percentage Fruit Collapse
1941	0.4
1942	0
1946	0
1947	0.8
1948	3.7
1949	4.5
1950	3.6
1951	5.8
1952	11.2
1953	10.3

The trend of these figures supports the belief that fruit collapse is most severe on young plantings.

Moisture

Field observations indicate that fruit collapse causes most damage in areas where drainage is poor and soil moisture content is therefore high. In some such heavily affected areas the severity of the disease has been reduced by improving the drainage.

High air humidity also favours the disease. This is shown by its greater prevalence in wet weather and also became evident in inoculation experiments. In these, infection did not take place unless a high humidity was maintained. In addition if, after infection, humidity was reduced, the progress of the disease was greatly retarded.

NUTRIENT STATUS

Information on the effect of different plant nutrients on fruit collapse incidence is available from four manurial trials laid down by the Agronomy Branch of the Department in the Pontian area of Johore. This information is summarised in Table III.

Table III

Effect of Manurial Treatment on Fruit Collapse Incidence

Experiment Number	Manurial Treatment (per acre)	Percentage Fruit Collapse
JP 5	A. 1 cwt. sulphate of ammonia	12.9
	B. 2 cwt. rock phosphate	11.0
	C. 2 cwt. muriate of potash	10.5
	D. A + B + C	12.9
	E. No treatment	11.2
JP 6	A. 1 cwt. sulphate of ammonia	5.1
	B. 2 cwt. rock phosphate	4.8
	C. 2 cwt. muriate of potash	4.4
	D. A + B + C	4.5
	E. No treatment	4.9
JP 7	A. 4 cwt. Sterameal	4.3
	B. A + E	4.6
	C. 10 cwt. magnesium limestone	4.9
	D. C + E	4.2
	E. 1 cwt. sulphate of ammonia, 2 cwt. rock phosphate, 2 cwt. muriate of potash	4.4
JP 17	A. 3 cwt. muriate of potash	5.1
	B. 2¼ cwt. muriate of potash	6.3
	C. 1½ cwt. muriate of potash	5.5
	D. ¾ cwt. muriate of potash	5.7
	E. No treatment	5.2

These figures indicate that none of the nutrients tried (nitrogen, phosphate, potash, magnesium) at the dosages used had any appreciable effect on the severity of the disease.

VARIETY

Commercial pineapple plantings consist almost exclusively of the variety Singapore Spanish, which is highly susceptible to fruit collapse. Little is therefore known about the susceptibility of other varieties growing under natural conditions. It has been reported, however, that fruits of the variety Selangor Green can be affected by the disease whereas the variety Sarawak appears to be immune. To obtain more information on varietal susceptibility artificial laboratory inoculations were carried

out. These indicated that Singapore Spanish, Selangor Green and Mauritius fruits are equally susceptible to fruit collapse but that Sarawak fruits, although not totally immune from attack, have considerable resistance to the disease.

Method of Spread

At the beginning of the investigation it was thought possible that the disease might be disseminated by insects. A search was therefore made for insects visiting both diseased and healthy fruits, only insects visiting both types of fruit being considered capable of acting as vectors.

On fruits affected by fruit collapse the following insects were found:

Glycyphana sinuata Wall (Coleoptera, Cetoniidae);
Carpophilus ?foveicollis Murr. (Coleoptera, Nitidulidae);
Haptoncus ocularis Frm. (Coleoptera, Nitidulidae);
Mimegralla sp. (Diptera, Micropezidae);
Lasiodactylus pictus Macl. (Coleoptera, Nitidulidae); and
?Cyclonotum sp. (Coleoptera, Hydrophilidae).

The beetles occurred at the base of the fruits, hiding amongst the subtending leaves and slips and probably feeding on exuded juice and decaying matter, while *Mimegralla* sp. was an occasional visitor to the rotted fruits.

These insects were not found on immature healthy fruits, nor are such fruits likely to be attractive to them. No other species of insect was found visiting immature fruit. From these observations it thus appears unlikely that insects are involved in the spread of the disease.

As it has since been found possible in the laboratory to cause infection merely by spraying uninjured fruits with a suspension of the pathogenic bacteria it is not necessary to postulate infection through injuries caused by insects or other agencies. It seems likely that spread of the disease normally takes place by means of chance infection with air-borne bacteria originating in plants affected by fruit collapse or heart rot.

Control

Normal practice on estates and smallholdings at present is either to leave *in situ* fruits affected by fruit collapse so that they eventually fall to the ground and disintegrate, or to cut them off and leave them lying on the ground. In either case the fruits remain as potentially dangerous centres of infection from which pathogenic bacteria may be disseminated and so spread the disease. The most essential step in controlling fruit collapse is therefore the disposal of all affected fruits as soon as they are discovered.

How to dispose of these fruits is, however, a difficult problem. The only practical method would appear to be by deep burial in pits but this method has the disadvantage that it involves a large amount of labour, particularly for the collection of the rotten fruits and their

transport to a central burial point. An alternative and cheaper means of disposal has been used for some time on the Federal Experiment Station, Alor Bukit, Johore. This is shallow burial of individual infected fruits, which are buried, as they are discovered, in shallow holes made with a *changkol* (a type of hoe), Although theoretically far from an ideal solution to the problem, incidence of fruit collapse on the Station is lower than in nearby areas and this may be at least partially due to the burial of rotten fruits.

Two experiments to discover whether fruit collapse can be controlled directly by protecting the fruits from attack have been completed.

In the first experiment the effect of weekly spraying of the young fruits with copper fungicides (which are also bactericides) was investigated. The fungicides used were Bordeaux mixture 4 : 5 : 40 and a copper oxychloride formulation (containing 50 per cent copper) used at a strength of one part in 200 parts of water. Spraying was continued from the end of flowering until maturity. Results of this experiment are shown in Table IV.

Table IV

Experiment on the Control of Pineapple Fruit Collapse with Copper Fungicides.

Treatment	Mean No. of Fruits per Plot Affected by Fruit Collapse	Percentage Affected Fruits
Copper oxychloride	21.0	8.0
Bordeaux mixture	20.5	7.8
No spray	16.8	6.4
Standard error (10 degrees of freedom)	2.3	—

Layout: X 6 randomised block

No significant effect on the number of fruits affected by fruit collapse was obtained by spraying with these copper compounds. They cannot, therefore, be used to control the disease.

In a second experiment the effect of spraying fruits with an antibiotic (streptomycin sulphate) was investigated. A 0.1 per cent solution of the streptomycin sulphate was sprayed on to the fruits at weekly intervals, treatment as in the first experiment beginning after the end of flowering and ending just before ripening.

As indicated by the results, summarised in Table V, at the one per cent probability level a significant decrease in the number of affected fruits was obtained by the treatment with streptomycin. The degree of control obtained was not very satisfactory. This, together with the high cost of weekly spraying, makes it impossible at present to recommend spraying with an antibiotic as a control measure. Nevertheless the results indicate that it might be possible to evolve a practical method of reducing the severity of the disease by using antibiotics.

Table V

Experiment on the Control of Pineapple Fruit Collapse with an Antibiotic.

Treatment	Mean No. of Fruits per Plot Affected by Fruit Collapse	Percentage Affected Fruits
Streptomycin	9.1	18.2
No spray	14.9	29.8
Standard error (7 degrees of freedom)	1.2	—

Layout: X 8 randomised block

Conclusions

The failure of copper compounds to reduce the incidence of fruit collapse and the doubtful efficacy of streptomycin rule out at present the possibility of obtaining direct control of the disease with these substances.

As regards the likelihood of being able to reduce the severity of the disease by the more indirect method of altering growing conditions, there is no evidence to show that changing the nutrient status of the soil will have any effect on the disease. Improving the drainage in poorly-drained areas is, however, likely to be beneficial.

The ideal solution to the problem of controlling the disease would be the production of a resistant variety. This might be possible by selection from the existing population of Singapore Spanish plants but is perhaps more likely to be achieved by breeding from the resistant Sarawak variety a type suited to local conditions and requirements.

Meanwhile, the conclusion to be drawn is that at present control of fruit collapse must depend on field hygiene *viz.* the safe disposal of infected fruit. This disposal of diseased material is particularly desirable during the off-seasons and at the beginning of the main fruiting periods, when the numbers of affected fruits to be dealt with are comparatively small and the work can therefore be carried out at relatively small cost. The removal of foci of infection at these times should do much to prevent heavy losses during the main fruiting seasons.

As fruit collapse is caused by the same organism that causes heart rot, it is desirable that all possible measures to control the latter disease should be taken. The measures advocated for heart rot control have already been described (1).

Summary

Pineapple fruit collapse is described and the factors affecting its occurrence are examined.

The disease is shown to be caused by a bacterium, identified as the same strain of *Erwinia carotovora* which causes pineapple heart rot.

In experiments on the control of the disease by spraying with copper fungicides and an antibiotic the latter gave partial control.

Acknowledgements

Thanks are due to Messrs H.K. Ashby and H.M. James, successive State Agricultural Officers, Johore, and their staff for supplying field data on the disease and carrying out field surveys and spraying experiments.

Messrs E.F. Allen and R. Henderson, successive Senior Agronomists, have also given valuable assistance by allowing data from agronomy experiments to be used in this paper.

References

(1) Johnston, A. (1957): "Bacterial Heart Rot of the Pineapple". *Malay agric. J.*, **40**, 1.

(2) Oxenham, B.L. (1957): "Diseases of the Pineapple." *Queensland agric. J.*, **83**, 13.

(3) Sideris, C.P. and Waldron, G.C. (1930): "Diseases of the Pineapple Fruit." *Pineapple News*, **4**, 79 (Abstr. in Johnson, M.O.: *The Pineapple.* Paradise of the Pacific Press, Hawaii, 1935.)

(4) Thompson, A. (1937): "Division of Mycology. Annual Report for the Year 1936." *Bull. No. 26, Gen. Ser., Dep. Agric. S.S. & F.M.S.*, 49.

(5) Thompson, A. (1937): "Pineapple Fruit Rots in Malaya." *Malay. agric. J.*, **25**, 407.

(6) Thompson, A. (1939): "Notes o nPlant Diseases in 1937-38." *Malay. agric. J.*, **27**, 86.

(7) Thompson, A. (1940): "Notes on Plant Diseases in 1939." *Malay. agric. J.*, **28**, 400.

(8) Wilshaw, R.G.H.: *Annu. Rep. Dep. Agric., Fed. of Malaya, 1948.* Govt. Press, Kuala Lumpur, 1949.

NATURAL CROSS-POLLINATION IN RICE IN MALAYA

BY

F. B. BROWN,

Senior Botanist.

Introduction

The inflorescence of the rice plant consists of a terminal panicle of hermaphrodite flowers and the dehiscence of the anthers takes place just before or simultaneously with the opening of the glumes. Self-pollination would therefore appear to be the method by which fertilisation is normally effected, but the existence of a certain amount of cross-pollination has been demonstrated in various countries and under varying conditions. A knowledge of the degree of cross-pollination is of importance in breeding work in that it enables the breeder to grow material in such a way that natural crossing is minimised or eliminated and it also finds use in the planning of effective roguing.

In a previous experiment Larter (1) estimated that the amount of natural cross-pollination in wet padi in Malaya was of the order of one per cent. The interpretation of the results of his experiment was somewhat limited by the non-availability of completely homozygous material. Such material has since been produced and the experiment was repeated with special emphasis given to the creation of conditions favouring natural cross-pollination and to the elimination of factors leading to excessive experimental error.

Materials and Methods

All varieties used, though thought to be homozygous, were further inbred for five generations by bagging individual plants at flowering time. The experimental material could therefore be assumed to be homozygous. As before, the female parents used were the pure line varieties Nachin 11, Siam 29, Milek Puteh 9 and Reyong 6. All are characterised by the absence of pigmentation in both vegetative and reproductive organs and all produce normal, white, vitreous rice. Awns are not present in any of them. Distinction can be made between these varieties by grain size and shape and by vegetative habit.

The male parents were also the same as in the previous experiment. All are little-known varieties, but all exhibit characters which are believed to be simple Mendelian dominants, such as pigmentation and presence of awned lemmae. Distinguishing features of both male and female parents are summarised in Table I.

Table I

PIGMENTATION OF PARENTS

Organ	Female Parents	Male Parents				
		Kedudok	Janda Mengikut	Merah Isi	Pulut Agam	Kelopak
Pulvinus	—	—	—	+	—	+
Internode	—	—	+	—	—	+
Glume	—	—	+	+	+	+
Lemma	—	+	+	+	+	—
Apiculus	—	—	+	+	+	+
Pericarp	—	+	—	+	—	+

+ = pigmented — = no pigmentation

In addition, all varieties except Kelopak are awnless and the endosperm of Pulut Agam is glutinous while those of the remainder are the vitreous type. Seed of all varieties was also hand-picked before sowing in order to eliminate any obvious rogues and diseased or imperfect grains.

The experiment was planted in ear rows of forty-two plants per row. Plants were 12 in. apart in the rows and there was a spacing of 18 in. between rows. These distances are the ones normally used in pure line selection work in Malaya. In order to ensure that natural cross-pollination would be given a chance to take place, a systematic layout was used. This was as follows:—

Row 1. All Kelopak.
„ 2. Alternate plants of Kelopak and Nachin 11.
„ 3. All Kelopak.
„ 4. Alternate plants of Kelopak and Siam 29.
„ 5. All Kelopak.
„ 6. Alternate plants of Kelopak and Milek Puteh 9.
„ 7. All Kelopak.
„ 8. Alternate plants of Kelopak and Reyong 6.
„ 9. All Kelopak.

This was repeated with the other male parents, giving a total of 45 rows. It will be noted that each female parent plant was surrounded by eight male parent plants.

In order to synchronise flowering, Kedudok was sown on the 12th August and the other varieties on the 29th July. Seedlings were transplanted when 35 days old. Normal growing conditions were experienced, but Merah Isi was badly attacked by rats at tillering time and consequently flowered much later than the other varieties. The nine rows in which it featured were, therefore, discarded. Flowering took place between the 28th December and the 10th January in favourable conditions with no rain in the mornings and only light showers before nightfall. All female plants were harvested, those from the same rows being bulked together.

The following season, random samples of seed were taken from each bulked sample and the F_1 generation was grown as six rows of fifty plants of each cross. Seed of the Siam 29 plants which had been grown in proximity to Kelopak was damaged during storage and was not planted.

Results

During the growing season, rats caused damage to most lines and those plants which were badly affected were not harvested. Results from the F_1 plants (see Table II) of the unpigmented varieties were as follows:—

Nachin 11

Rows 1 to 6 (Kelopak). Three plants were off-types, one with the Nachin grain type but having a coloured apiculus and two with a red pericarp.

Rows 19 to 24 (Pulut Agam). Two off-types, one identical with Pulut Agam and most probably a rogue and the other having the grain shape of Pulut Agam but with vitreous endosperm.

Rows 43 to 48 (Janda Mengikut). No off-types.

Rows 67 to 72 (Kedudok). No off-types.

Milek Puteh

Rows 7 to 12 (Kelopak). Two off-types, both with pigmented apiculus and pericarp but otherwise similar to Milek Puteh 9. Both probably hybrids.

Rows 31 to 36 (Pulut Agam). One off-type with a pigmented apiculus—a probable hybrid.

Rows 55 to 60 (Janda Mengikut). No off-types.

Rows 79 to 84 (Kedudok). Fifteen off-types. Thirteen identical with Siam 29 and one identical with Reyong 6, all considered rogues; one probable hybrid with the characters of Milek Puteh 9 but with a coloured apiculus.

Reyong 6

Rows 13 to 18 (Kelopak). Five off-types. Three with pigmented apiculus and pericarp and with grain shape intermediate

between Reyong 6 and Kelopak—therefore hybrids; two identical with Kelopak, so considered to be rogues.

Rows 37 to 42 (Pulut Agam). One off-type identical with Siam 29 —a rogue.

Rows 61 to 66 (Janda Mengikut). One off-type identical with Kelopak—a rogue.

Rows 85 to 90 (Kedudok). Two off-types with greyish grains and pigmented pericarp but otherwise like Reyong 6 —hybrids.

Siam 29

Rows 25 to 30 (Pulut Agam). Eleven off-types identical with Reyong 6 and considered to be rogues.

Rows 49 to 54 (Janda Mengikut). Two off-types, one having a pigmented apiculus and grain but with the intensity of pigmentation much less than in Janda Mengikut—hybrid—and one plant identical with Reyong 6—a rogue.

Rows 73 to 78 (Kedudok). Five off-types, one similar to Siam 29 but with pigmented pericarp—hybrid—and four identical with Nachin 11—rogues.

These results are summarised in Table II.

An F_2 generation which was grown subsequently confirmed the validity of the assumptions made as to the nature of the off-types of the F_1 generation.

Conclusions

The degree of out-crossing which occurred under the conditions of this experiment can be expressed as 15/3691 or 0.41 per cent. Steps were taken to eliminate all factors which were likely to influence the true percentage, and it is therefore concluded that the figure is reasonably accurate. It corresponds well with the degree of hybridity found by Larter (0.48 per cent) and workers in Ceylon. It is surprising, however, that in spite of all precautions taken nearly one per cent of all the plants were rogues. One can therefore presume that in trials conducted under normal conditions a much higher percentage of rogues can be expected. The great necessity of a thorough roguing of seed plots is apparent.

There is also some indication that varieties differ in their susceptibility to out-crossing. The variety Kelopak has given rise to 100 per cent more hybrids than any of the other three male parents used. Such an occurrence has been noted by other workers who have also found differences in different localities. This is a point worthy of future investigation in Malaya.

Reference

1. Larter, L.N.H. (1950): "Natural Cross-Pollination of Wet Padi in Malaya." *Malay. agric. J.*, **33**, 82.

Table II

OCCURRENCE OF OFF-TYPE PLANTS IN THE F_1 GENERATION

Varieties	Row Nos.	Surrounding Plants in Previous Year	No. of Plants Harvested	Hybrids	Per Cent Out-Crossing	Rogues	Off-Types	
							Total	Per Cent
Nachin 11	1-6	Kelopak	252	3	1.19	—	3	1.19
	19-24	Pulut Agam	244	1	0.41	1	2	0.82
	43-48	Janda Mengikut	234	—	—	—	—	—
	67-72	Kedudok	231	—	—	—	—	—
Total			961	4	0.42	1	5	0.52
Milek Puteh 9	7-12	Kelopak	220	2	0.91	—	2	0.91
	31-36	Pulut Agam	241	1	0.42	—	1	0.42
	55-60	Janda Mengikut	241	—	—	—	—	—
	79-84	Kedudok	265	1	0.38	14	15	5.66
Total			967	4	0.41	14	18	1.86
Reyong 6	13-18	Kelopak	268	3	1.12	2	5	1.87
	37-42	Pulut Agam	268	—	—	1	1	0.37
	61-66	Janda Mengikut	225	—	—	1	1	0.44
	85-90	Kedudok	277	2	0.72	—	2	0.72
Total			1,038	5	0.48	4	9	0.87
Siam 29	25-30	Pulut Agam	256	—	—	11	11	4.30
	49-54	Janda Mengikut	235	1	0.43	1	2	0.86
	73-78	Kedudok	234	1	0.43	4	5	2.14
Total			725	2	0.28	16	18	2.49
Grand Total			3,691	15	0.41	35	50	1.35

A TEST OF SPRAY DEPOSITS ON CACAO FOLIAGE USING A FLUORESCENT TRACER

BY

MAJORIE HENDERSON

Entomologist

Introduction

There has been some uncertainty about the use of fogging as a method of application of insecticides to cacao, the debatable point being whether fogging results in an efficient residual deposit of insecticide on foliage or whether it can only be used for direct control of insects in the area at the time of treatment. It was therefore decided to carry out a test to compare the amounts of deposit on foliage given by both wet and dry fogging with that given by mist spraying. A method of detecting spray deposits using fluorescent tracers, described by Sharp (1), seemed suitable for the test and a supply of a fluorescent material, zinc-8-hydroxyquinolinate, was obtained. This compound is non-water-soluble but forms a fine suspension in both water and oil. Preliminary tests showed that it was possible both to spray and to fog these suspensions and that the resultant particles of zinc-8-hydroxyquinolinate on cacao leaves fluoresced with a clear, bright green colour in ultra-violet light. The test was carried out at the Federal Experiment Station, Serdang, on the 30th September and 1st October, 1957.

Method

The area available for the test consisted of about two acres of 5½-to-6-year-old cacao trees planted at 10 x 10 ft. spacing. Three plots, A, B and C, were marked out on 30th September as shown in Figure 1, each plot being approximately 0.275 acre. Larger plots could not be used due to the uneven growth of trees in parts of the area, which had to be avoided.

In order to obtain a representative sample of foliage from which to assess the deposit after treatment, leaves from the top, middle and lower levels on two sides of sample trees were labelled on 30th September. Ten sample trees were chosen in each plot and the leaves were selected in the following manner:—

(a) Six leaves on the side of the tree nearest the 'front' of the plot (Side 1) comprising:—

Two leaves at the end of a branch roughly 9 ft. from the ground—('Top').

Two leaves at the end of a branch roughly 5 ft. from the ground—('Middle').

Two leaves at the end of a branch roughly 3 ft. from the ground—('Bottom').

(b) A further six leaves on the side of the tree nearest the 'back' of the plot (Side 2) were chosen in the same manner.

Each leaf was labelled by looping a cardboard label and string around the base of the petiole. Some sample trees had no branches at the requisite heights and it was therefore not possible to label the full number of twelve leaves on each tree. The total number of leaves labelled in each plot was as follows:—

Plot A — 110 leaves
Plot B — 102 ,,
Plot C — 100 ,,

Half an ounce of the fluorescent material, zinc-8-hydroxyquinolinate, was applied to each plot on 1st October by the following methods:—

Plot A—suspended in three pints of diesolene and applied as a dry fog using the Swingfog, model SN6, with the fogging outlet nozzle and flow control jet 0.8.

Plot B—suspended in three pints of diesolene and applied as a wet fog using the Swingfog, model SN6, with the atomiser, outlet nozzle and flow control jet 1.4.

Plot C—suspended in fourteen pints of water and applied as a mist using the Motoblo machine with nozzle No. 1.

Fogging was done from 7 to 8 a.m. along every third row of trees; the fog rose slightly and there was some drift down towards the river. Mist spraying was done at 10 a.m., when the leaves were dry, along every row of trees. These procedures accord with the normal practice on cacao and the lines of fogging and spraying are shown on Figure 1.

Sample leaves were collected from each plot about one hour after treatment when the deposit had dried. They were cut off below the petiole, carried by the label and string, and transported to Kuala Lumpur in specially constructed boxes to prevent the deposit being rubbed off. Assessment of the amount and distribution of deposit on each leaf was done on 1st and 2nd October using an ultra-violet lamp in a dark-room.

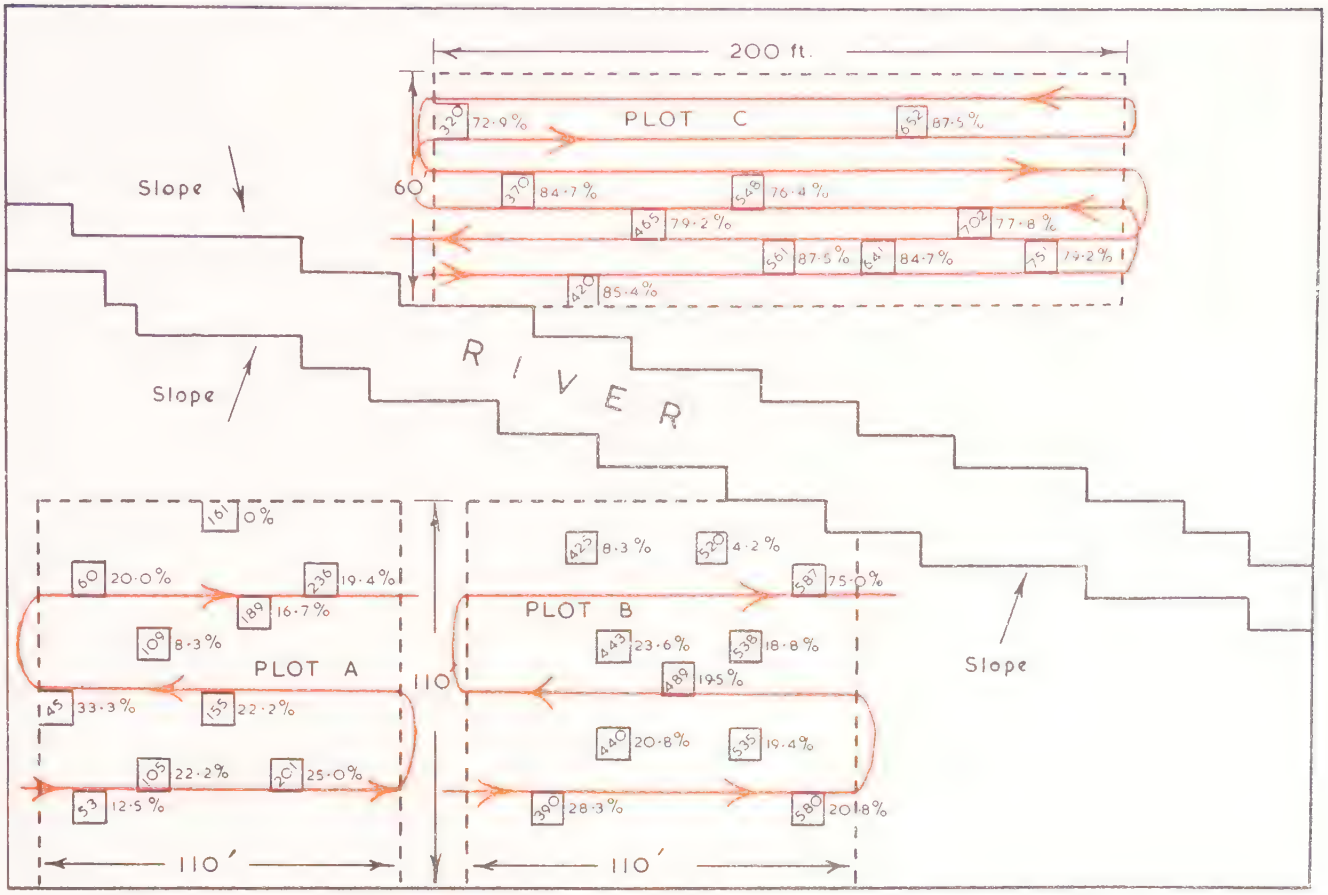
Results and Discussion

To be effective, a residual deposit of insecticide on foliage must be sufficient to cover the surface of the leaves and be evenly distributed over the surface. It was therefore decided to assess both amount and distribution of deposit on the upper and lower surfaces of each sample leaf. Quantitative measurement of amount of deposit was not possible as a fluorimeter was not available. Therefore, a series of seven standard leaves was prepared beforehand ranging from a leaf with no deposit, scored as 0, to a leaf with a heavy deposit, scored as 6. The top and bottom surfaces of each sample leaf were compared separately with the standards under ultra-violet light and a score was given accordingly. To assess the distribution of deposit, sample leaves were placed in one of two categories: "even" when the fluorescent material was evenly distributed over the whole surface and "patchy" when the deposit was in one or more well separated

Fig. 1

TEST OF SPRAY DEPOSITS

Plan of The Area Showing Layout of Plots



□ = Sample Trees → = Lines Of Fogging or Spraying Figures in Squares = Tree Numbers

Amount of Deposit per Tree Shown as % (see Table I)

patches with areas between free from deposit. Scoring for all plots was done by the same two people, each person scoring half the total number of leaves in each plot.

Results of the scoring for amount and distribution of deposit on the upper surfaces of the leaves are summarised in Tables I and II. Plot

Table I

AMOUNTS OF DEPOSIT ON UPPER SURFACES OF LEAVES

N.B.—Maximum possible score for 1 leaf = 6

Plot	Tree No.	Side 1 'Top' 2 leaves	Side 1 'Middle' 2 leaves	Side 1 'Bottom' 2 leaves	Side 2 'Top' 2 leaves	Side 2 'Middle' 2 leaves	Side 2 'Bottom' 2 leaves	Total/Max. Score per Tree	% Deposit
A (*DRY FOG*)	45	2	2	4	5	5	6	24/72	33.3
	53	0	0	—	2	4	—	6/48	12.5
	60	5	4	—	2	1	0	12/60	20.0
	105	2	5	3	2	2	2	16/72	22.2
	109	0	0	—	2	2	—	4/48	8.3
	155	2	2	3	2	2	5	16/72	22.2
	161	0	0	0	0	0	0	0/72	0
	189	2	2	3	1	2	2	12/72	16.7
	201	3	6	3	2	2	2	18/72	25.0
	236	4	4	4	0	1	1	14/72	19.4
Total/Max. Score		20/120 (16.7%)	25/120 (20.8%)	20/84 (23.8%)	18/120 (15%)	21/120 (17.5%)	18/96 (18.8%)	122/660	18.5
B (*WET FOG*)	390	2	6	6	1	2	—	17/60	28.3
	425	2	2	—	0	0	—	4/48	8.3
	440	1	2	6	2	2	2	15/72	20.8
	443	1	3	1	5	2	5	17/72	23.6
	489	2	3	2	2	1	4	14/72	19.5
	520	1	1	1	0	0	0	3/72	4.2
	535	2	4	2	2	2	2	14/72	19.4
	538	2	4	—	2	1	—	9/48	18.8
	580	0	—	—	5	—	—	5/24	20.8
	587	8	8	10	8	10	10	54/72	75.0
Total/Max. Score		21/120 (17.5%)	33/108 (30.6%)	28/84 (33.3%)	27/120 (22.5%)	20/108 (18.5%)	23/72 (31.9%)	152/612	24.8
C (*MIST SPRAY*)	320	8	9	—	8	10	—	35/48	72.9
	370	11	12	9	9	10	10	61/72	84.7
	420	8	—	10	11	12	—	41/48	85.4
	465	8	9	—	10	—	11	38/48	79.2
	548	8	8	6	12	10	11	55/72	76.4
	561	10	10	—	12	10	—	42/48	87.5
	641	10	6	10	12	12	11	61/72	84.7
	652	8	10	—	12	12	—	42/48	87.5
	702	8	9	11	12	9	7	56/72	77.8
	751	10	9	10	11	9	8	57/72	79.2
Total/Max. Score		89/120 (74.2%)	82/108 (75.9%)	56/72 (77.8%)	109/120 (90.8%)	94/108 (97%)	58/72 (80.6%)	488/600	81.3

Table II

DISTRIBUTION OF DEPOSIT ON UPPER SURFACES OF LEAVES

Plot	Distribution of Deposit	No. of Leaves per Plot				% Total Leaves Sampled per Plot
		'Top'	'Middle'	'Bottom'	Total	
A (*DRY FOG*)	Even	14	22	14	50	45.5
	Patchy	23	13	10	46	41.8
	No deposit	3	6	5	14	12.7
B (*WET FOG*)	Even	15	13	10	38	37.3
	Patchy	17	18	13	48	47.1
	No deposit	7	5	4	16	15.7
C (*MIST SPRAY*)	Even	30	30	15	75	75.0
	Patchy	10	6	9	25	25.0
	No deposit	0	0	0	0	0

C had the greatest total amount of deposit and this appears to have been evenly distributed over the plot as a whole, since all leaves sampled had received some deposit; also, the deposit was spread evenly over the upper surfaces of most leaves, since only 25 per cent of the leaves sampled showed a patchy distribution of deposit. Plots A and B had less deposit; 13 per cent and 16 per cent of the leaves sampled had no deposit, which would indicate that the deposit had not been evenly distributed over the plots, and about half the sample leaves with deposit had the deposit unevenly spread over the upper surfaces.

There is no great difference between the deposit on the 'top', 'middle' and 'bottom' leaves in any plot; this may be because the 'top' leaves were not taken from a sufficiently high level. There is, however, an indication in Plot B that the 'bottom' leaves have received more deposit; this would be expected as the larger droplets in the "wet" fog would rise less and settle more quickly than the smaller droplets of the "dry" fog. In Plot C the droplets were also large but were directed upwards on each tree with considerable force.

Comparing the distributions of deposits over the plots as shown by the percentage deposit on each individual tree (see Table I, last column, and Figure 1) it would seem that in the fogged plots, A and B, trees more than one row away from any line of fogging did not receive much deposit, e.g. trees 161A, 425B and 520B. This indicates that with fogging a reasonable deposit may only be given within 10-15 ft. of the nozzle of the machine in a low-branching tree crop such as cacao. In relation to this, it is also interesting to note that in Plots A and B the side of the tree nearest to the line of fogging usually had the most deposit. The exceptionally high score for tree 587B is probably due to a minor breakdown of the

Swingfog which occurred near that point and involved the operator standing near that tree with the machine in operation for several minutes. There is not much difference in amount of deposit between trees in Plot C, as would be expected when each tree had been sprayed individually.

Results of the scoring for amount and distribution of deposit on the under surfaces of the leaves are given in Table III. Very few leaves in the fogged plots had any deposit on the under surface. In the mist-sprayed plot about 50 per cent of the leaves had a deposit—mainly the upper leaves, as would be expected. Neither fogging nor mist-spraying resulted in an efficient coverage of the lower surfaces of the leaves.

Table III

DEPOSIT ON UNDER SURFACES OF LEAVES

Plot	Position of Leaves on Tree	Total No. of Sample Leaves per Plot	No. of Leaves with Deposit on Under Surface	Average Amount of Deposit per Leaf (maximum = 6)	Distribution on Leaves: No. of Leaves per Plot	
					Even	Patchy
A (*DRY FOG*)	'Top'	40	2	1.5	0	2
	'Middle'	40	6	1.3	3	3
	'Bottom'	30	3	2.0	0	3
	Total	110	11	1.2	3	9
B (*WET FOG*)	'Top'	40	0	0	0	0
	'Middle'	36	1	1.0	0	1
	'Bottom'	26	1	1.0	0	1
	Total	102	2	1.0	0	2
C (*MIST SPRAY*)	'Top'	40	21	3.4	11	10
	'Middle'	36	18	2.6	4	14
	'Bottom'	24	9	1.1	0	9
	Total	100	48	2.7	15	33

Summary and Conclusions

A test to compare the amounts of residual deposit on cacao foliage given by dry fogging, wet fogging and mist-spraying is described.

A fluorescent compound, zinc-8-hydroxyquinolinate, was used in the test to detect the deposits and was applied according to the normal practices of fogging and mist-spraying cacao.

The results of this test indicate that both wet and dry fogging will give some deposition on the foliage of cacao but only on trees fairly close to the line of fogging. The amount of deposit given by these methods of

application and its distribution over the foliage as a whole and on individual leaves would probably not give an effective coverage of insecticide. Mist-spraying appears to be a far more efficient method of distributing the same amount of material evenly over the foliage to give a residual deposit. The relative costs of the three methods have not been taken into account in this comparison; these will vary due to the different intervals between the operators' movements in fogging and in spraying.

The method employed in the test is, in the writer's opinion, an extremely useful one for field assessment of the distribution and amounts of spray deposits.

Acknowledgements

My thanks are due to Mr. D. M. Haynes, Agricultural Engineer, for his advice and help and to Mr. Kao Wei Tsun, Assistant Chemist, for preparing the fluorescent material. I am also grateful to Enche Kamardin bin Bahar, Assistant Research Officer, and other staff of the Entomology Division for their assistance in carrying out the trial.

References

(1) R.B. Sharp: "Detection of Spray Deposits using Fluorescent Tracers." *Tech. Memor. No. 119, National Institute of Agricultural Engineering.*

INSECTICIDAL CONTROL OF THE DIAMOND BACK MOTH (*Plutella Maculipennis* Curt.) ON CABBAGES AT CAMERON HIGHLANDS

BY

MAJORIE HENDERSON,

Entomologist.

Introduction

Leaf feeding by caterpillars of *Plutella maculipennis* can cause severe damage to cabbages and other cruciferous vegetable crops. In the past, successful control of this pest was maintained by regular spraying with DDT or BHC insecticidal formulations. During 1956 reports were received from Singapore, Johore and Cameron Highlands that DDT and BHC were proving ineffective against *Plutella* larvae and, that in Cameron Highlands, spraying with dieldrin was also giving poor results. An experiment was therefore designed to test the effectiveness of these three insecticides and, at the same time, to compare them with two newer insecticides, malathion and diazinon, in the control of *Plutella*.

The Experiment

Cabbages are normally a popular crop with Chinese vegetable growers at Cameron Highlands but *Plutella* damage had become a serious problem there. The experiment was therefore laid down on a crop of cabbages at the Federal Experiment Station, Cameron Highlands, and carried out by the Station staff.

It was decided that DDT, BHC and dieldrin should be applied at the concentrations normally used in the area and malathion and diazinon be applied at double the concentration recommended by the manufacturers, since Cameron Highlands normally has a high rainfall. The treatments were therefore as follows:—

Treatment	*Insecticide*	*Formulation*	*Concentration*	*Percentage Active Ingredient*
A	DDT	25% miscible liquid	6 c.c. in 1 litre	0.15
B	*gamma*-BHC	Agrocide dispersible powder (6.5% *gamma*)	1 gm. in 1 litre	0.03
C	dieldrin	Dieldrex 15	10 c.c. in 1 litre	0.15
D	malathion	malathion emulsifiable concentrate (57%)	5 c.c. in 1 litre	0.28
E	diazinon	Basudin 20E	2 c.c. in 1 litre	0.04
F		Control		

These treatments were replicated in four randomised blocks as shown in the following diagram:—

Block I				Block II							
D	F	C	A	B	E	D	C	E	B	A	F
B	F	E	A	C	D	A	D	C	E	F	B
Block III				Block IV							

Each plot was 5 x 11 ft. and was surrounded by a 1 ft. path or drain.

The cabbages, variety Japanese Succession, were transplanted into the plots on 12th February, 1957; planting distance was 2 x 2 ft. giving 18 plants per plot. Eighteen pounds of compost were mixed into the soil over the entire experimental area before planting and five pounds of the following fertilizer were applied per plot at one, three and five weeks after transplanting:—

Prawndust	30 parts
Groundnut cake	25 ,,
Sulphate of ammonia	5 ,,
Christmas Island rock phosphate	35 ,,
Muriate of potash	5 ,,

All plots receiving treatments A to E were sprayed immediately after transplanting and then weekly until 24th April, 1957. The insecticidal solutions were applied with a "Four Oaks" hand sprayer; 375 c.c. of solution was used per plot for the first five applications but this was increased to 500 c.c. per plot for the last five applications to give adequate coverage of the plants. No guard rows were left as canvas screens were used between the plots while spraying.

Plutella infestation was assessed by weekly counts of the numbers of living caterpillars on four outer leaves per plant. These counts were done on a nine-plant sample in each plot immediately before each application of insecticides; a summary of the results is given in Table I.

Table I

Total Number of Living *Plutella* Larvae per Treatment Counted on the Four Outer Leaves of a Nine-Plant Sample per Plot. (36 plants per treatment).

Date of Count	Weeks after Transplanting	Total Number of Larvae per Treatment					
		A	B	C	D	E	F
19.2.57	1	0	0	0	1	0	2
26.2.57	2	10	10	2	2	0	9
5.3.57	3	62	72	4	0	0	77
12.3.57	4	131	117	1	2	2	227
19.3.57	5	112	131	10	3	1	136
26.3.57	6	135	133	13	5	0	92
2.4.57	7	96	124	27	4	3	71
9.4.57	8	73	63	19	0	7	67
16.4.57	9	36	32	17	5	0	31
23.4.57	10	52	58	12	2	0	46
	Grand Totals	707	740	105	24	13	758

Infestation in the control plots, F, was heavy and it is obvious that Treatments C, D and E had considerable effect in reducing the numbers of caterpillars. Treatments A and B appear to have been ineffective, except possibly during the earlier stages of growth of the plants. As these counts were restricted to four outer leaves only, they

are probably not an accurate representation of the total population of caterpillars per plant, especially during the later stages of growth: therefore the results have not been analysed statistically.

Harvest of the crop was completed by the 22nd May, 1957, and the total weight of cabbages per plot recorded. On the 7th May, 1957, two weeks after the final spraying, three cabbages from each treatment were sent to Kuala Lumpur for analysis of insecticidal residues on the leaves.

Effectiveness of the treatments was mainly judged on the yields of harvested cabbages, but market appearance of the crops and insecticidal residues were also taken into consideration. The mean yields of cabbages from each treatment, in pounds per plot and tons per acre, are given in Table II.

Table II

Mean Yield of Cabbages per Treatment.

	Treatment Means						Gen. Mean	S.E. of Mean	M.S.D. 0.1%
	A	B	C	D	E	F			
lb. per plot	27.72	31.03	50.50	50.61	56.53	12.92	38.22	± 1.542	8.88
tons per acre	9.8	10.9	17.8	17.9	19.9	4.6	13.5	± 0.544	3.14

Treatment means A to E were compared statistically with F, the control, by a *t* test and all insecticidal treatments have resulted in a significant increase in yield over that of the control ($P = 0.001$). The mean yields of the five treated plots were further tested by a range test; at the five per cent level Treatment E has resulted in the greatest yield and Treatments C and D have greater yields than A and B. There is no significant difference between the yields of C and D or between those of A and B.

It was not possible for a visit to be made to the experiment at the time of harvest, so market appearance of the cabbages was assessed by an eye score for degree of *Plutella* damage, done on the three cabbages per treatment which were sent to Kuala Lumpur for chemical analysis. A scale from 0 for little or no damage to 5 for heavy damage was taken, giving a possible maximum of 15 per treatment. The score was done by two people independently and the mean score per treatment is shown in Table III.

Table III

Eye Score for *Plutella* Damage

(Maximum score (heavy damage) = 15)

Treatments	A	B	C	D	E	F
Score	12.0	7.5	2.5	2.5	1.0	14.5

Cabbages from Treatment F were heavily damaged and had a very poor market appearance, those from A and B were a little better, from C and D only slightly damaged and from E hardly damaged at all. The difference in appearance at harvest between cabbages from Treatment F and those from Treatment E is shown in Plates I and II.

A chemical analysis was done on the three cabbages per treatment sent to Kuala Lumpur at harvest. No insecticidal residue was found on cabbages from Treatments A, B, D and E but cabbages from Treatment C had a residue of 3 p.p.m. dieldrin. This is a fairly high figure compared with the U.S.A. tolerance of 0.25 p.p.m. in or on cabbages at harvest (1). Dieldrex 15 therefore would appear to be too persistent an insecticide to be used with safety on a short-term food crop such as cabbages.

Discussion

The above experiment has shown that spraying at weekly intervals with DDT (0.15 per cent active ingredient) or BHC (0.03 per cent active ingredient) will not give effective control of *Plutella* larvae on cabbages at Cameron Highlands. In previous years good control was reported in that area by both these insecticides used at lower concentrations, so it is possible that resistance to them has been developed by *Plutella* larvae. Weekly spraying with a Dieldrex 15 solution containing 0.15 per cent dieldrin effectively reduced the numbers of larvae and appreciably increased the yield; thus reports of the ineffectiveness of this insecticide appear ill-founded. However, residues of dieldrin on the leaves at harvest make its use unsafe on a short-term food crop such as cabbages and it is therefore *not* recommended.

Of the insecticides tested, the most promising one for the control of *Plutella* appears to be diazinon. In this experiment, ten weekly applications of a Basudin solution containing 0.04 per cent diazinon gave almost complete control of the caterpillars and resulted in an increase in yield of 15 tons of cabbages per acre for an outlay of approximately $152 per acre on insecticide. Providing that spraying is stopped two weeks before harvesting, there should be no danger from insecticidal residues.

Malathion sprayed at a dilution containing 0.28 per cent active ingredient also gave good control although in this experiment it was slightly less effective than diazinon. Further experimental work is planned to compare a newer formulation of malathion with Basudin 20E and also to discover whether lower concentrations and longer intervals between application of insecticides will still result in effective control while reducing the cost of treatment.

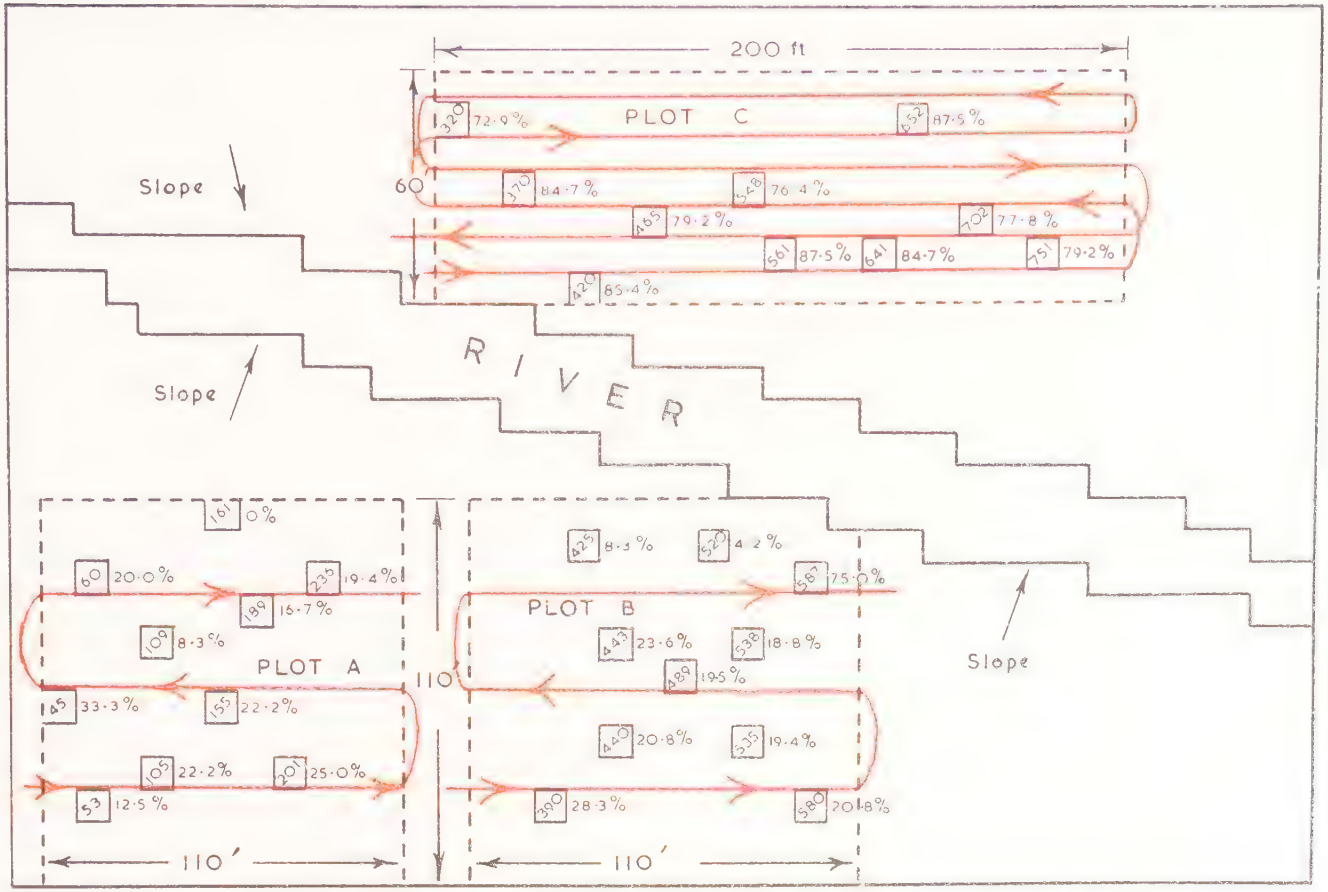
Summary

An experiment to compare five insecticidal treatments in the control of *Plutella maculipennis* on cabbages is described. The most successful control was effected by spraying at weekly intervals from transplanting to two weeks before harvest with a solution of Basudin 20E containing 0.04 per cent diazinon.

FIG. 1

TEST OF SPRAY DEPOSITS

Plan of The Area Showing Layout of Plots



□ = Sample Trees → = Lines Of Fogging or Spraying Figures in Squares = Tree Numbers

Amount of Deposit per Tree Shown as % (see Table 1)

Solutions of dieldrin and malathion also gave good control but the use of the former is not recommended as residues of insecticides remained on the leaves at harvest.

Spraying with DDT and BHC proved ineffective and it appears that *Plutella* larvae at Cameron Highlands are now resistant to these insecticides.

Acknowledgements

My thanks are due to Mr. N. Kanagaratnam, Agricultural Development Officer, Mr. T. Sockalingam, Agricultural Assistant, and the staff of the Federal Experiment Station, Cameron Highlands, for carrying out the above experiment.

Reference

(1) Federal Register of the United States. Vol. 21, Number 74. April 17, 1956.

KEDAH PADI PLANTERS BOARD

BY

A. L. BARCROFT,

State Agricultural Officer, Kedah/Perlis,

and

OTHMAN BIN MOHAMED LELA,

Assistant Agricultural Officer, Kedah Central.

Introduction

The decrease in the Government support price of padi from $17 to $12 per picul in December, 1954, caused general dissatisfaction among padi planters and as a result the Federal Government set up a Committee to enquire into their economic status. One of the recommendations of this Committee was that funds should be provided to give assistance to padi planters.

Thereupon, in March 1955, a State Committee was appointed by His Highness, the Ruler in Council, to consider methods of utilising the funds allocated by Federal Government for the long term benefit of the padi planters. This Committee, under the Chairmanship of the State Agricultural Officer, Kedah/Perlis, Mr. E.J.H. Berwick, recommended that the funds should be used to assist the formation of Associations of Padi Planters and to redeem land subject to *jual janji**. This recommendation was approved at a meeting of the Council of State held on 11th June, 1955, and an allocation of $4,600,000 was received from the Federal Treasury at the beginning of July, 1955. A census of padi planters was immediately carried out and work commenced on the formation of the Divisions of the Associations, and on the drafting of legislation to provide for the establishment of the Lembaga Kemajuan Penanam2 Padi (Kedah Padi Planters Board).

The Lembaga Kemajuan Penanam2 Padi (Kedah Padi Planters Board)

On the 15th December, 1955, an Enactment to establish a fund to provide assistance to padi planters in the State of Kedah, and known as the Kedah Padi Planters Board Enactment 1955 was passed by the Council of State. The purpose of the legislation was to create an incorporated body to administer funds which had been voted by the Federal Government for the benefit of the padi planters in the State of Kedah. The Enactment also prescribes the functions and the constitution of the Board and gives it the power and the means to carry out these functions.

* *jual janji* = mortgage.

The Board consists of the following persons appointed by the Ruler in Council.

(a) The State Secretary,
(b) Five Government servants,
(c) A representative from each of the 18 Divisions of the Padi Planters Association,
(d) A representative of the North Kedah Cooperative Banking Union Limited, and
(e) A representative of the Central Kedah Cooperative Banking Union Limited.

The defined objects of the Board are:—

(a) to assist in the working of any association of padi planters approved by the Ruler in Council and, if it thinks fit, to provide financial assistance in ways approved by the Ruler in Council to the said association;
(b) to purchase padi land for resale, mortgage or rent to padi planters; and
(c) to make proposals for schemes for the benefit of padi planters and to give effect to such of the said schemes as the Ruler in Council may approve as being for the benefit of padi planters, either collectively or individually.

The assets of the Board comprising $4.6 million are divided into two funds, namely the Capital Fund and the Revenue Fund. The Capital Fund consists of an initial sum of $4.5 million and all other moneys which may be paid into it and all other assets of the Board not forming part of the Revenue Fund. The Revenue Fund consists of an initial sum of $100,000 plus all sums obtained by ways of income, profit, or interest upon the use of the Capital or Revenue Fund.

The normal business of the Board is carried out by a Working Committee which consists of the Deputy Chairman of the Board, the Secretary of the Board (Kedah Civil Service Official), the State Agricultural Officer, the State Welware Officer, the State Treasurer, the Secretary General and four other representatives of the Persekutuan Penanam2 Padi Kedah from the Board proper.

The Activities of the Board.

As stated previously the objects of the Board are, firstly, assisting associations of padi planters and, secondly, the implementation of approved schemes for the benefit of padi planters either collectively or individually.

(a) *Assistance to Persekutuan Penanam2 Padi Kedah (Padi Planters Association).*

Every assistance was provided in encouraging the formation and expansion of the Padi Planters Association. The Board pays to the Association in respect of every duly registered member the entrance fee of 50 ct. and the annual subscription of 50 ct.

(b) *Implementation of approved schemes for the benefit of padi planters.*

(i) *Redemption of bendang (padi land) held under jual janji (mortgage)*

Priority in the activities of the Board under approved schemes is given towards the redemption of *bendang* held under *jual janji*. Up to the end of September 1957, the Lembaga had redeemed an aggregate area of 1,558 acres of *bendang* at a total cost of $631,338.

(ii) *Redemption of bendang held under gadaian (usufructuary loan)*

Next priority was afforded to redemption of *gadaian* or *sandaran*, where *bendang* land is pledged to Chettiars, Chinese, or Malays. A total area of 1,292 acres was redeemed for $175,519.

(iii) *Purchase of bendang for resale to padi planters.*

Towards the end of 1956, the Board extended its activities in regard to approved schemes for the benefit of padi planters to include the purchase of *bendang* land for resale to padi planters. To date, an aggregate area of 668 acres was purchased at a total cost of $549,249.

Up to the end of September, 1957, some 891 padi planters had benefitted from the activities of the Board in respect of redemption of *bendang* held under *jual janji* and *gadaian*, and purchase of *bendang*.

All *bendangs* redeemed under *jual janji* and *gadaian* are registered in the name of the Board. Former owners are permitted to repay the sum expended by the Board, in yearly instalments over a period not exceeding 10 years, but are required in addition to pay rental at the rate of 130 *gantangs* * of padi per annum for every $1,000 expended, during the period of repayment. (i.e. about 6½ per cent).

In regard to purchase of *bendang* the sum expended by the Board is restricted to a maximum of $700 per *relong* † for Class I *bendang*, $600 for Class II *bendang* and $350 for Class III *bendang*. Where the cost exceeds the maximum imposed, any cultivator wishing to purchase the land is required to pay the excess. Period of repayment is limited to 15 years and a rental of 130 *gantangs* of padi per annum is charged for every $1,000 expended.

Schemes to enable padi planters to purchase rubber, dusun, coconut holdings etc. are under active consideration and may be implemented shortly.

A scheme has been devised to enable padi planters to obtain loans for the purchase of buffaloes, repayment of loan being over a period of three years. On account of the large number of applications for such assistance received by the Board, no loans have so far been approved.

* 1 *gantang* = 1 gallon or 5.6 lb. padi.

† 1 *relong* = 0.71 acre.

Persekutuan Penanam2 Padi Kedah
(Padi Planters Association)

The Association is financed by the Board. In respect of every member registered with the Association the Board pays the entrance fee of 50 ct., in addition to the annual subscription of 50 ct., to the Association. Of the total income received in this way by the Association from the Board, 40 per cent is retained by the Headquarters of the Association, the remaining 60 per cent being divided equally between the Divisions and Branches concerned.

The main object of the Association is to unite all padi planters in Kedah into an organised body in order to improve their economic status and protect their interests.

In order to achieve the aforementioned objective, the members of the Association pledge:—

(a) To work in co-operation with the Padi Planters Board.
(b) To co-operate with all technical Department's concerned with the padi industry.
(c) To establish libraries for members.
(d) To organise youth and womens' movements etc.

There are three types of members, namely—

(a) Founder members,
(b) Ordinary members, and
(c) Life members.

At the end of October, 1957, the Association comprised 18 divisions with 219 branches throughout the State, the total registered membership being 36,804.

The Authority of the Association is vested in the Representatives Delegate Conference, to which each Division is permitted to send one elected representative in respect of every 1,000 members in the Division. 20. Each Division elects its representative to sit on the Padi Planters Board, where the Association has in all, 18 representatives, i.e. one from each Division.

There are about 65,000 padi planters in Kedah who are eligible for membership of the Association. Actual membership of 36,804 is only 57 per cent of the total possible membership. All branches are actively campaigning for more members; naturally more members means a greater measure of financial help from the Board.

All applications for redemption of *jual janji*, *gadaian* and purchase of *bendang* are first scrutinised by the Branch Committee, then by the Divisional Committee, and finally by the Working Committee of the Association. If the latter body supports the application, this is then forwarded to the Working Committee of he Board for examination and decision.

MASTER FARMERS OF MALAYA, III
YAACOB BIN SULONG

BY

HUSSEIN BIN ISA

Junior Agricultural Assistant, Special Grade, Kelantan.

Introduction

During the past two years a register of progressive farmers has been kept in Kota Bharu District, whether they be owners of padi, dusun or coconut smallholdings. Any farmer who is interested in and acts upon the advice of the Department of Agriculture is noted, and when he has carried out improvements to his holding and practises good agricultural husbandry as laid down by the Department, then he is registered as a progressive farmer. Having been so registered, he receives preferential treatment in having free issues of fertilizers, pruning saws, secateurs, etc., made to him. His holding is then clearly labelled as a progressive holding. The main objects of this policy of extension work are, firstly, to follow-up success, and secondly, to encourage other farmers to do likewise by arranging for them to visit progressive farms to see for themselves what can be done, especially to holdings on the Kelantan plain.

It might be a criticism of this type of extension work that too much "spoon feeding" is done by the Department, but only those farmers who are anxious and eager to improve their holdings are chosen and a balance is always maintained between Departmental aid and the work due to be carried out by the farmers themselves.

A good extension officer is born, not made, the most important quality in an extension officer being personality, and that quality is inherent in some and unfortunately not in others. However, every officer can make the most of his character in his work and relationship with the farmers by following the principles as suggested below:—

(a) In having sufficient practical agricultural experience in order to obtain the confidence of the farmers;
(b) In being extremely tactful when contacting a farmer;
(c) In being patient with him at all times;
(d) In keeping as close a contact as possible;
(e) In being honest and straightforward in one's dealings;
(f) In performing personal services to the farmers at odd times (it helps a lot to carry a few aspirins, bandages etc. on one's travels. They are often needed);
(g) In showing to the farmers that one is not tied down by office hours and by behaving well at all times;
(h) To know thoroughly all the interests of the farmer other than agriculture. In Kelantan dove keeping is a popular hobby,

and if one is able to talk 'doves' to a farmer, the farmer is pleased and ready to listen to your advice;

(i) In giving aid to the farmers when necessary in the form of materials only, such as fertilizers, pruning saws, etc.

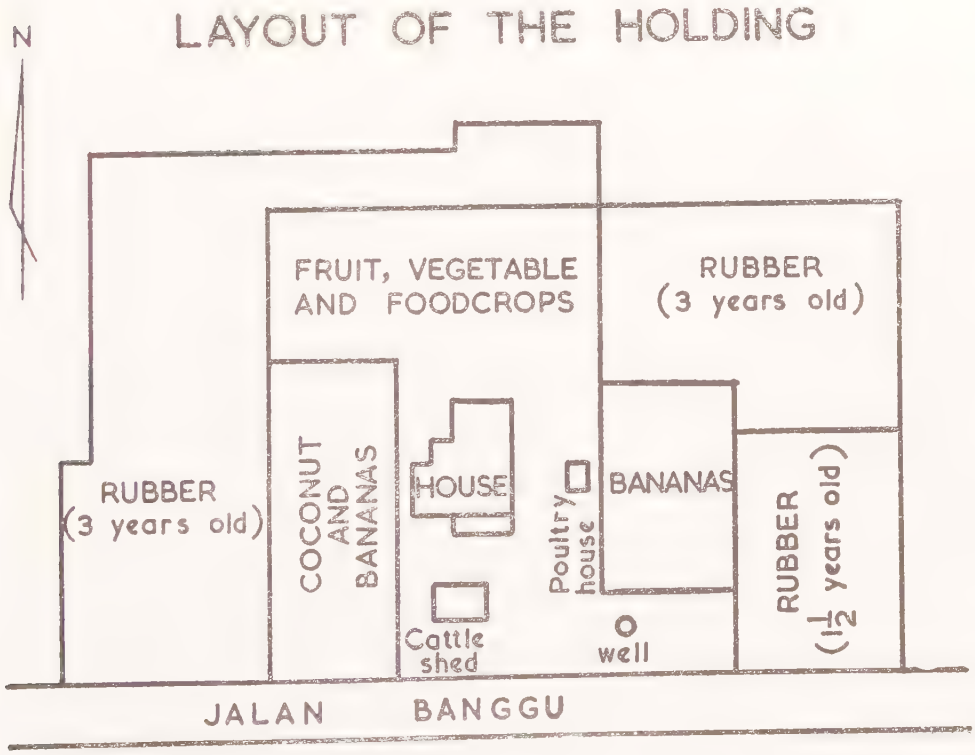
I have selected at the moment nine such progressive farmers, and this is the story of Che Yaacob bin Sulong, a Malay farmer, and a description of his holding on the Kelantan plain.

Yaacob's Farm

Pa'Cob, as Che Yaccob is known, is now 60 years old and lives at kampong Tualang Patah with his wife, son aged 25 years, daughter-in-law and grandchild.

He does all the work himself on his holding, except that he is sometimes helped by his son in cultivating his padi land. His holding consists of 4 acres of rubber, replanted under the replanting grant in 1955, 2½ acres of padi and 4 acres consisting of 90 mature coconut palms, 40 rambutans and 250 bananas, as well as a small area under vegetables, tobacco and sugar cane (see Fig. I).

Fig. I



When one considers that Pa'Cob was left only one-half acre of vacant land and no money when his father died some 35 years ago, it is not surprising that he has been selected as a progressive farmer. From this one-half acre which he intensively cultivated with vegetables and food crops—such as brinjal, cucumber, sugar-cane, bananas, sireh and pineapples—he received sufficient income to purchase by installments other lots of land over the years and so gradually increased his holding. Until he obtained ownership of the rubber and padi lands, he farmed them under the *pawah* (crop-sharing) system. To-day he has 10½ acres of land, as mentioned previously, including a fine house in the middle of his holding.

Rubber Lot (4 acres).

The old rubber was replanted early in 1955 with clonal seedlings under the Smallholders Rubber Replanting Scheme and is well maintained; a majority of the trees are expected to come into tapping in the next three years or so.

Padi Lot (2½ acres).

During the present (1957-58) padi season, Pa'Cob manured his wet padi seedlings in the nursery with ammonium phosphate at the rate of 2 lb. per gantang of seed. He has also carried out manuring in the field with cattle manure and with the recommended inorganic fertilizer at 100 lb. per acre. His previous yields when not using fertilizer and farm-yard manure averaged approximately 320 gantangs per acre, giving a total yield of 800 gantangs from his padi lot. He kept 400 gantangs for home consumption and sold the remaining 400 gantangs at 50 to 55 cents per gantang. This year he expects a total yield of at least 1,200 gantangs at an average yield of 480 gantangs per acre. If he sells 800 gantangs, as he proposes, he will have therefore *doubled* his income from the sale of padi this year by following the Department of Agriculture's advice in using fertilizers.

Coconuts.

All the trees are growing well, and Pa'Cob has agreed to manure them with *baja bakar* and cattle manure. His yield is 1,600 fresh nuts per year, of which he keeps 200 for house consumption and sells the remaining 1,400 at 10 cents each.

Fruit Trees.

All the rambutan fruit trees are of clonal material comprising mainly the local clone *Che Embong*. Pa'Cob regularly practises pruning and manuring, in which he is now an ardent believer. From his sale of fruit he receives an income of approximately $250 per year, but many fruits are given away free to his friends.

Bananas.

The bananas planted are all of good varieties. He never allows more than three stems per point and each plant is manured regularly.

PLATE I

Pa'Cob, his wife, son and grandchild of Kampong Tualang Patah on the Kelantan plain.

PLATE II

Pa'Cob feeds his poultry.

PLATE III

Pa'Cob establishes stylo under young rubber for feeding to his farm animals.

PLATE IV

Every morning Pa'Cob takes his cattle out of the cattle shed.

PLATE V

Pa'Cob takes straw for bedding from his reserves of baled straw.

PLATE VI

The straw is spread in the cattle shed for bedding.

Clean weeding is rigorously carried out, and all dead leaves, fronds, etc. are placed around each point for mulch. It is estimated that Pa'Cob receives an income of $375 per year from the sale of fruit and $60 per year from the sale of suckers.

Miscellaneous Crops.

A few plants of tobacco and a few beds of vegetables such as chillies, brinjal and cucumber are planted each year, from which he derives an annual income of approximately $45, after home consumption has been satisfied.

Sugar-cane is planted with the sole purpose of meeting land assessment dues, which amount to some $15 per year. From 45 points of sugar-cane planted early in the year and harvested at the end of the year, he obtains an income of $60. For some reason known only to Pa'Cob, he must pay his assessment dues out of his sugar-cane and not from any other sources of income. Consequently, sugar-care is planted each year.

Pa'Cob is an enthusiastic believer in planting stylo, (*Stylosanthes gracilis*), for feeding to his cattle, and this he has established under his young rubber and fruit trees.

Cattle Shed and Poultry House.

Pa'Cob is a good livestock-man also, and was one of the first of the Kelantan farmers to follow the Department of Agriculture's advice in building a cattle shed and planting stylo. He has two head of cattle, fully realizes the benefit of properly made cattle manure and believes in plenty of straw for bedding. He made full use of the Department's baler last padi harvest and thus obtained sufficient baled straw for his needs during the year.

A flock of 50 local hens with a pure Rhode Island Red cockerel is allowed to run on free range during the day under the fruit and bananas. They are, however, housed at night in a poultry house. Pa'Cob is very pleased with his half-bred poultry, which gives a bigger bird at an earlier age compared with the local kampong birds. He makes sure that all his birds are inoculated against ranikhet disease when six weeks ago.

Conclusion

Pa'Cob (Che Yaacob) is a progressive farmer, not because he is helped by the Department but because he is *hard working* and *industrious*. He is a man whose mind is receptive to new ideas and methods and he is not content to use those practices and methods which his father and grandfather before him employed. He has absolute confidence in the Department of Agriculture and consequently he has become an unpaid extension worker for the Department itself whenever visits by other farmers are made to his holding. The real success of his holding is due to the fact that he realizes that *the sweat of one's brow is the best fertilizer available.*

MASTER FARMERS OF MALAYA, IV
MOHAMED YUSOF BIN HUSSIN

BY

E. F. ALLEN

Acting Asst. Director of Agriculture, Field.

Introduction

There was once a time when padi competitions at State and District Agricultural Shows were strongly criticized by padi experts on the grounds that the qualities required of a prize winner were not necessarily those found in farmers who were economically successful.

Much has been done to meet this criticism by adjusting show rules whereby the competitor must enter not only two gantangs of padi but also a bunch of 100 ears taken from the same crop. This has ensured that prize-winning entries have been both heavy-yielding and unblemished from pest attack since only the finest crops will yield heavy, clean ears with well-filled grain.

How far these new rules have been successful may be judged from the results of the 1957 All-Malaya Padi Competition in which the first-prize winner was found to be a highly skilled farmer who has had a record in the past both of good yields of high-quality padi and of consistent success in competitions.

Mohamed Yusof bin Hussin

Mohamed Yusof, Dato' Ampat of Ulu Yam Mukim in Ulu Selangor, farms two acres of padi land in the Kalong Tengah Irrigation Area. The soil is a well-drained, sandy clay loam of no great fertility but it has an excellent water supply.

Last season Mohamed Yusof grew 1¾ acres of a large-grained Siam-type variety which he has selected himself and ¼ acre of Selayap. In the past he has used no fertilizers and it is therefore surprising that he obtained such a high yield as 450 gantangs per acre.

Why is it that Mohamed Yusof can grow such a heavy crop of excellent quality padi without the help of fertilizers? The secret of his success lies in following good farming practices at every stage in the growth of the crop. He selects his seed-grain with meticulous care, using only heavy ears of well-filled, plump grains. These are sown thinly in a well-prepared, wet nursery site on fertile soil and the nurseries are carefully tended and protected against rodent and insect pests. Healthy seedlings are transplanted in well-cultivated fields when 44 days old and these are spaced in regular rows 12 x 12 in. apart. After completion of transplanting Mohamed Yusof takes particular care to keep his fields well-weeded so that the young seedlings receive no check in

PLATE I

Mohamed Yusof bin Hussin with the first-prize silver cup which he was awarded in the All-Malaya Padi Competition held at the Malayan Agri-Horticultural Association's Exhibition in July 1957

PLATE II

Mohamed Yusof walks to meet Mohamed Ali bin Hamid, the Agricultural Assistant for Ulu Selangor, who is coming to discuss crop prospects with him.

PLATE III

Mohamed Yusof and Mohamed Ali discuss which fields should receive a trial application of fertilizers. Note the absence of weeds and the excellent water control.

PLATE IV

Mohamed Yusof and his wife start harvesting on January 31st 1958.

PLATE V

His daughter also helps with the harvest.

PLATE VI

Mohamed Yusof expects a good crop this year, especially where he has used fertilisers.

PLATE VII

He discusses the harvest prospects with the Penghulu of Ulu Yam.

growth and they soon shade out any further weed growth. This practice helps to prevent insect damage and the well-trimmed batas provide no cover for rats.

There is another reason for the vigorous weed-free growth of padi on this farm. In the off-season Mohamed Yusof cultivates one acre with maize and groundnuts, which he manures with burnt refuse and wood ashes. These crops are well tended and this helps greatly with weed control in the padi season. The rest of his farm is too wet to be cropped in the off-season, but a green manure plant called *Crotalaria* seeds itself and provides a quick-growing bush cover which adds both organic matter and nitrogen to the soil.

The secret of present success lies in hard work and a first-class irrigation supply. What then of the future? Can these yields be maintained or increased? The answer is an emphatic *yes*. This year Mohamed Yusof has used fertilizers as recommended by the Department of Agriculture on two of his fields and the present indications are that the crop from these fields will show a considerable increase over last season. If the crop fulfils its present promise Mohamed Yusof may be expected to use fertilizers next season both on his padi nurseries and on the whole of his farm.

Success in Competitions

For three years Mohamed Yusof has won a second prize in the All-Malaya Padi Competition and in 1957 he achieved his ambition of being awarded first prize with a truly magnificent entry of his own Siam-type selection, of which he has maintained pure lines for years. The expert padi judges were so impressed by the quality of his padi that this variety is now in cultivation at the Pulau Gadong Padi Experiment Station, Malacca, where it is being kept under observation. If it continues to show its present high quality and high-yielding capacity it is safe to predict that our plant breeders will use it in future hybridizing programmes.

Discussion

Although Mohamed Yusof cultivates too small a padi farm to produce much of a surplus for sale he nevertheless has consistently raised good crops of top-quality padi and he has also obtained good yields of maize and groundnuts in the off-season. With the help of fertilizers there seems no reason why he should not increase his padi yields to between 550 and 600 gantangs per acre and this can be expected to have a beneficial effect on his dry-land crops. He is already a natural farmer who is not afraid of hard work; with the help of modern techniques he will become one of Malaya's *Master Farmers* who will be a fine example to his neighbours in the irrigation area.

NOTES ON CURRENT INVESTIGATIONS AND EXTENSION WORK

July to September, 1957.

Weather

The weather was dry throughout the quarter in Negri Sembilan, Malacca and on the Selangor coast, but July and September were unusually wet in the north, especially on the Kelantan plain. Floods of short duration were recorded in Perlis and on the Johore coast.

Padi

Of five introduced Sarawak padi varieties under test in Kedah and Malacca only one failed to lodge and that, Engkatek, gave the lowest yield. At Kapala Batas in Kedah, however, this variety and Indai Empati outyielded the popular Kedah variety Subang Intan (S.I.) 117 by nearly 20 per cent. At Seriab in Kedah, Serendah Sungei Dua (S.S.D.) 19 significantly outyielded Anak Didek (A.D.) 22 and 39, and S.S.D. 25 over a four-year period.

Forty-eight new padi hybrids have been produced and planted. In all, there are over 3,000 hybrid lines under development which will begin to produce high-yielding varieties for distribution in five years time.

Of 76 varieties introduced for trial from six East Asian countries 63 have been retained for further trial; the remaining 13 grew too poorly to survive.

An investigation has been commenced to study varietal susceptibility to *Helminthosporium oryzae*, which is probably the most serious disease of padi in Malaya.

Fertiliser extension trials on cultivators' land have been continued in the States of Kedah, Penang, Kelantan, Trengganu, Selangor, Negri Sembilan and Malacca, and more comprehensive experiments on padi test stations in many parts of the country.

About 6,650 acres of off-season padi were harvested in ideal weather in Province Wellesley, where the crop gave the high average yield of 372 gantangs * per acre. Further north in the Yen district of Kedah, also, the off-season crop did very well and 462 acres gave an average yield of 460 gantangs per acre; this sold readily at 47 to 50 cents per gantang.

The only other padi planted in the off-season was in south Krian where 180 acres of *japonica* padi grew very well but this was somewhat scattered and pest damage was severe.

In the main season, progress with planting has been generally satisfactory and crop prospects are good. Some flood damage has been

* 1 gantang = 1 imperial gallon or 5.6 lb. padi.

reported from Perlis where nurseries sown with 3,000 gantangs of seed were destroyed, but farmers were encouraged to re-sow with shorter-term varieties and 220 gantangs of seed and surplus seedlings have been distributed free by the Department.

The use of fertiliser is increasing steadily, not only in States where it is subsidised but elsewhere also. In Kelantan and Trengganu respectively 176 and 125 tons have been sold; in Johore 20 tons have been sold at half price; in Negri Sembilan and Malacca sufficient fertiliser has been sold for manuring 1,824 acres of padi land.

In Kedah and Perlis, where there is no fertiliser subsidy, bat guano is still used widely and 60,000 gantangs have been distributed from Bukit Chuping alone. However, other fertilisers are also used and in Kedah these include 358 tons of rock phosphate, 45 tons of sulphate of ammonia and about 5 tons of double superphosphate and urea. Christmas Island rock phosphate is popular in Penang where 375 acres have been dressed with 150 lb. per acre. A similar practice is becoming popular in Krian, Perak.

The use of fertiliser is actively encouraged by talks and the distribution of leaflets but demonstrations in the field are still the most effective method of extension. So far, 505 field demonstrations have been laid down, as well as 482 demonstrations of nursery manuring. Field demonstrations usually take the form of two adjacent plots, one manured and the other unmanured. However, larger blocks have their uses, especially where improved methods other than manuring are also being shown in the fields of farmers who are particularly progressive. The use of such "Progressive Farmers" has been particularly successful in the north-east, where 22 such farmers have been selected in Trengganu and 17 in Kelantan. Similarly, twelve fields of one-half or one acre each have been manured in Penang.

Nursery manuring with ammonium phosphate 11 : 48 gives good results almost everywhere. This produces fine robust seedlings and it has been reported from Kedah that these show some resistance to crab damage. A fertiliser dressing higher in nitrogen gives too lush a growth and the leafy seedlings are often damaged by rats. In the reclaimed padi area at Beranang, Selangor, the response to nursery manuring has been spectacular and it is expected that at least 1,000 acres will be planted there, largely with manured seedlings.

A total of 32,182 gantangs of pure-strain padi has been distributed and also 6,362 gantangs of other varieties. Pure-strain padi is being bulked up on 50 Padi Experiment and Test Stations and also on special seed farms. In Malacca there are two such seed farms this season: one of 40 acres of the variety Nachin 5057 at Bukit Rambai and a 12-acre farm of Serendah Kuning 3 at Bachang. A contract for a third farm has been cancelled because of unsatisfactory husbandry.

In Malacca the use of selected varieties is publicised by demonstrations, of which 60 have been organised and most have been planted.

In Kelantan the variety S.I. 117 has performed well and a few demonstrations have been laid down on farmers' land. It is also being bulked up on Padi Stations so that a major campaign of distribution can be planned for next season.

At Pasir Tumbok, Kelantan, an extra 65 acres of land were planted with padi after a successful Departmental campaign for the eradication of water hyacinth.

In Kelantan the planting of lowland dry padi was held up by dry weather in July whereas the later wet weather interfered with sowing and weeding. As a result, only 22,450 acres have been planted as compared with 30,180 acres in the previous season. However, most of the unplanted fields will probably be planted up with short-term wet padi after commencement of the monsoon.

Some 2,065 acres of upland dry padi in Trengganu and 1,000 acres in Pahang have been planted on new land opened up for fruit and rubber planting. Early growth has been good.

In Trengganu five tractors have been in use for land preparation in dry padi areas and there has been a good demand for tractor hire in Negri Sembilan where 363 acres of padi land have been mechanically cultivated.

In Perlis some damage from caseworms has been reported but prompt demonstrations by a Departmental pest-control team have brought these under control and 4 cwt. of BHC dusting powder have been distributed free to 380 farmers.

Five hundred and fifty-two lb. of poison bait have been distributed and, in Kedah alone, 32,990 rats and bandicoots have been killed, mostly by poison baiting.

The activities of the Padi Planters Board in Kedah are summarised in the following table:—

Activity	*Area (Acres)*	*Number of People Benefited*	*Expenditure*
Redemption of mortgages	174	49	$ 79,205
Redemption of usufructuary loans	285	79	104,399
Purchase of land for resale to tenants	231	51	189,781
Total	690	179	$373,385

In Perlis the sum of $589,056 has been paid direct to farmers as a form of padi aid with up to a maximum of $80 paid per farmer.

Rubber

The administration of the Pool of Rubber Planting Material continues to occupy a great deal of time both at Headquarters and in

States. This has been a particularly busy quarter since 14,585,820 clonal seed have been distributed and sown in nurseries, while the sale of planting material to new and replanters has been in full swing. Actual distribution figures are given below:—

Distribution	*Budwood (yd.)*	*Clonal Seedling Stumps*
To new planters	19,492	437,069
To replanters	58,892	1,222,310
Total	78,384	1,659,379

A survey of the planting material likely to be available during the the next quarter has revealed that there will be sufficient supplies for replanters with a reasonable surplus for new planters.

The rubber seed fall has been somewhat disappointing in spite of its sudden onset in late July. Crops have been particularly heavy in Perak but very disappointing in Negri Sembilan and on the Selangor Coast. The main fall ceased somewhat abruptly in mid-September and later harvests have been light. The export ban on Tjir. 1 selfed seed remains in force.

Considerable interest continues to be shown in new planting by smallholders and recent alienations of land for this purpose have totalled 4,000 acres in Pahang and 1,705 acres in Trengganu. In Johore 1,000 acres have been new planted.

Nine latex purchasing schemes in Perak and four in Kedah have purchased the equivalent of 332,575 lb. of dry rubber during the quarter.

Practical demonstrations of lining, contouring and holing have been given in eight villages in Ulu Kelantan.

Sixty smallholders in Batang Kali, Selangor, are using sodium arsenite to eradicate lalang. The poison is stored on the adjacent Agricultural Station.

Twenty-five smallholders on the Maran Road, Pahang, have formed a joint nursery for the production of budded stumps.

Coconuts

Collection of seed nuts from high-yielding mother palms at Port Swettenham and their planting at the Federal Experiment Station, Telok Bharu, is continuing. About ten acres were established. Technicians have been trained and pollination of high-yielding palms at Port Swettenham and on a Selangor estate is commencing.

An obscure disease of old palms has appeared in the Batu Pahat area of Johore. It is characterised by leaf withering, the older leaves being first affected. At present the disease appears only sporadically and it is reminiscent of diseases of unknown origin occurring in the West Indies and the Philippines. Its cause is being investigated.

Good yields are reported from smallholdings on Pulau Tioman where a man with five acres expects to sell 65 pikuls of copra per annum or 12.8 pikuls per acre. This is sold in Mersing, Johore, at $18 per pikul. The time spent in harvesting and processing the nuts amounts to 4 months per year.

Floods in August did some damage to young palms on the west coast of Johore but the Drainage and Irrigation Department completed a cut joining the Parit Pulai and Parit Kemudi gates in early September and this led to an immediate subsidence of flood waters.

Nine manurial demonstrations have been laid down in Trengganu, three on young palms and six on mature palms. Four similar demonstrations laid down by the Department in Kelantan have already led to a colour change in the foliage of manured palms and smallholders in this State have subsequently put down an extra 14 manurial observations.

Over 200 acres of new planting have been reported from the Bachok district of Kelantan.

It was noted that applications of Dowpon to grass in an area of immature coconuts at the Federal Experiment Station, Serdang, had had no apparent ill effects on the growth of the coconuts some four months after application.

Demonstrations of lalang control with Dowpon applied at 20 lb. per acre have given promising results in the Sabak Bernam and Kuala Selangor districts of Selangor and one smallholder has purchased 40 lb. of the herbicide for use on his holding.

Pineapples

Prices remain low in Johore but some rehabilitation measures have been noted on estates. In Perak the Jendarata cannery has purchased 334,137 lb. of smallholders' fruit while the Klang cannery has bought 1,522,047 lb.

Observations of the growth of pineapples in a trial at the Federal Experiment Station, Jalan Kebun, suggested that the use of paper mulch improved growth of both the Sarawak and Singapore Canning varieties but that pineapple refuse mulch was harmful because it harboured mealy bugs which caused the development of wilt. In addition to the good effect on growth of pineapples it was noted that paper mulch substantially reduced the incidence of weeds.

Other Fruit

Good crops of all the seasonal fruits have been reported from most States and prices have been satisfactory.

There is always a keen demand for clonal fruit trees and the Department has sold 12,181 during the quarter while commercial nurseries have sold 6,520 budded plants.

It is reported from Johore that Singapore residents frequently

drive up to the Ayer Hitam Agricultural Station in order to buy budded fruit trees because the prices are much higher in the Colony.

At the Federal Experiment Station, Serdang, preparation of material for citrus rootstock trials was continued. This work was also in progress at the Federal Experiment Station, Kuala Lumpur. Studies were undertaken of the vigour of citrus seedling growth in order to discover if there is any simple method of detecting nucellar seedlings.

Cacao

Symptoms of leaf yellowing and shoot die-back were less evident at the Federal Experiment Station, Jerangau, during the quarter. Yields of pods from the seed gardens at this Station were appreciably higher than in the same period of 1956, and in one area were higher than for the whole of 1956.

In the Jerangau Pilot Scheme forest thinning has continued in preparation for planting of 30 acres next quarter. The participants have been able to afford to work only three days a week, so holing has been given out on contract in order to save time.

Growth of seedlings in the nurseries has been good although some showed sickle-leaf symptoms. Experience has shown that this disappears after planting out.

Coffee

The Klang price for dried beans of Liberian coffee has risen to $140 to $145 per pikul.

About half of the 45 acres planted in Negri Sembilan under the Rubber Replanting Scheme has come into bearing and the crop looks very healthy.

Thirty acres of Liberian coffee have been catch-cropped in hedge-planted rubber near Johore Bahru and this also is coming into bearing. In the same State eight acres were destroyed by August floods in the Sri Menanti area.

Cloves

Penang trees were in flower at the end of September and a good crop was expected. Up to date, 3,040 trees out of an estimated total of 12,000 in the Island have been replanted under the Rehabilitation Scheme.

Arrangements have been made to plant demonstration plots on both Pulau Perhentian and Pulau Redang off the coast of Trengganu in order to provide impoverished fishermen with a possible cash crop.

Pastures, Fodders & Livestock

The highest yields of Guinea grass ever obtained at the Federal Experiment Station, Serdang, were harvested from a manurial trial. The

best yield for the year ending in August, 1957, was 73 tons of fresh grass per acre.

The fodder legume *Stylosanthes* is being established throughout Kelantan by a vigorous extension campaign whereby smallholders are encouraged and helped by the Department to plant plots of up to half an acre each. Funds for this work have been provided from the vote for assistance to padi cultivators and it is planned to have 154 plots planted by the end of the year. This fodder is gaining in popularity among padi farmers who feed it to their cattle and buffaloes.

Departmental sales of Middle White pedigree pigs have totalled 49 boars and 54 gilts. In addition 380 services have been carried out in new villages and 23 at stud farms.

Sales of poultry for breeding have totalled 42 cockerels, 81 pullets and 738 eggs for hatching.

Sales of goats have totalled 12 animals, six bucks and six does.

Plant Diseases

Bacterial wilt caused by *Pseudomonas solanaccarum* is a limiting factor in the cultivation of tobacco and related crops in Malaya. The possibilities of its control by soil fumigants, flooding and antibiotics are being investigated.

Two new diseases, on *Sansevieria* and *Desmodium*, and a number of new host-parasite relations have been recorded. Investigations are continuing on control of *Curvularia* blight of oil palm seedings, *Ganoderma* infection from dead stumps and blister blight of tea. Previously reported work on pest control is continuing, but the large volume of advisory work under way in the Plant Pathology, Entomology and Chemistry Divisions prevents new investigation being undertaken with the staff available.

Food Preservation

The first series of six courses in food bottling, canning, and preserve and jam making for the instruction of members of Women's Institutes has been completed. Thirty-six trainees attended and the success of the enterprise is indicated by a request for a repetition of the courses next year.

Preliminary canning trials of rambutans have shown promise and the work has been extended to test 13 different varieties. The possibility of canning locally-produced ginger root in syrup is also being investigated.

The use of 'Permutit'-treated water for preparation of canning syrup has failed to prevent staining of the tin plate inside the cans.

Preservation of concentrated pineapple juice by pasteurisation resulted in colour deterioration and taint; the possible use of sulphur dioxide was therefore investigated, but this leads to bleaching and loss of flavour. Preservation of unsterilised samples by refrigeration has so far proved satisfactory.

Soil Surveys

In connection with the soil survey programme, 15,931 soil analyses have been carried out during the quarter, in addition to analyses of fertilisers, water samples and plant specimens.

Preliminary work on survey of the soils of the Kelantan coastal plain has shown them to fit into five main groups; detailed mapping is now proceeding. Aerial photographs of this area have proved particularly helpful, often enabling the main soil boundaries to be mapped with a minimum of ground surveying.

Survey of the upland soils of Ulu Kelantan is proceeding more rapidly than was expected and should be completed by the middle of 1958. The quality of soils in and around the Kemahang Forest Reserve and Kuala Krai is very variable but some good soils are being found. In some areas the land has been found to be more undulating than the topographical maps indicate and it is often too steep for agricultural development.

Smaller surveys have been completed or are in progress in the Besut irrigation area and at Paya Pending near Dungun in Trengganu; at Bukit Goh and Paya Besar in Pahang; at Bendang Bayas and Ulu Bernam in Perak and the Juru-Jajawi Drainage Scheme in Province Wellesley. In addition, soil surveys of most of the Padi Test Stations which had not previously been surveyed have been carried out.

Education

Nineteen courses have been held at Rural Agricultural Training Centres in Kedah, Selangor, Negri Sembilan, Johore, Pahang and Kelantan. These have trained 261 pupils. In addition, various special tours and visits have been arranged.

During the quarter four Malay and one Chinese Newsletters were published, of which 39,200 copies were distributed free.

STAFF NOTES

Awards

Editor's note: It is regretted that two errors occurred in the notes on awards in the last issue of the Journal. The two items under that section should have been as follows:

Tuan Haji Mahmood bin Haji Ya'acob, Assistant Agricultural Officer, Kelantan, was awarded the Seri Mahkota Kelantan by H.H. the Sultan of Kelantan on the occasion of His Highness's birthday on August 9th, 1957.

Encho Hussein bin Isa, Junior Agricultural Assistant, Kelantan, was awarded the Pingat Bakt by H.H. the Sultan of Kelantan on the occasion of His Highness's Birthday on August 9th, 1957.

Promotions

The following promotions have been approved:

Name and Rank	*Promoted as*	*Date*
A.L. Barcroft	Senior Agricultural Officer, Grade A	2. 7.57
G.S. Keeping	Senior Agricultural Officer, Grade B	2. 7.57
	and then to Senior Agricultural Officer, Grade A	5. 9.57
H.S. Matheson	Senior Agricultural Officer, Grade B	5. 9.57
	and then to Senior Agricultural Officer, Grade A	13.10.57
J.L.B. Hitchcock	Senior Agricultural Officer, Grade B	13.10.57

Appointments

The following appointments have been made:

Name and Rank	*Appointed as posted as*	*Date*
A.L. Barcroft	State Agricultural Officer, Kedah-Perlis	2. 7.57
A. Johnston	Ag. Senior Entomologist, in addition to his own duties	5. 8.57
G.W. Arnott	Acting Senior Chemist	15.10.57
T.R. Dickinson	Acting State Agricultural Officer, Perak	18.10.57
L.A. Vivian	State Agricultural Officer, Negri Sembilan	29.10.57
Mohd. Noor bin Haji Abdul Hamid	Acting State Agricultural Officer, Trengganu	30.10.57
Yap Sin Hee	Exectuive Officer	30.10.58

J.K. Coulter	Acting Assistant Director (Research)	1.12.57
A.R. McWalter	Ag. Senior Chemist (Soils)	1.12.57

Retirements

The following officers have retired under the Tenth Schedule to the Federation of Malaya Agreement (Amendment No. 1) Ordinance, 1956: -

Name	*Date*
H.M. James	12.10.57
Dr. C.C. Webster	26.10.57

Leave

The following officers have proceeded on leave prior to retirement:

Name and Rank	*Date*
M.J. Strickland, Agricultural Officer	18.10.57
D.W.M. Haynes, Agricultural Engineer	25.10.57
L.N.H. Larter, Assistant Director (Research)	30.11.57

The following officers have proceeded on leave:

Name and Rank	*Date*
G.F. Darnell, Agricultural Officer	28.10.57
F.N.G. Conaty, Senior Chemist	15.10.57

The following officers have returned from leave:

Name and Rank	*Date*
L.A. Vivian, Agricultural Officer	3.10.57
H.F. Logan, Administrative Officer	14.10.57
N. Kanagaratnam, Agricultural Development Officer	25.11.57
T.B. Wilson, Agricultural Economist	23.12.57

STATISTICS

July to September, 1957.

Rubber.—The average daily prices paid for R.S.S. No. 1 (f.o.b. in bales, buyers) in Singapore declined gradually during the third quarter from a high of 94.00 cents per pound on the 16th July to 82.25, the lowest average daily price of 1957 up to that date, on the 24th September.

Average prices for the months of July, August and September were 92.79, 91.37 and 85.73 cents per pound, respectively.

The average prices paid for smallholders' rubber at three towns in the Federation of Malaya are given in Table I. Table II shows production figures.

Padi.—Summaries of the acreages and production of padi in the Federation of Malaya in the 1956-57 season are shown in the following tables: Table IX, Total Wet and Dry Padi; Table X, Wet Padi; Table XI, Upland Dry Padi; and Table XII, Lowland Dry Padi.

Tea.—About 1,300,000 lb. of tea were produced in the Federation of Malaya in the July-September period, a decrease of 150,000 lb. over the previous quarter. The average prices paid in London for teas from Malaya and other countries are shown in Table III.

Coffee.—Table IV shows Liberican coffee prices at two towns in Selangor.

Other Agricultural Products.—The production figures for palm oil appear in Table V and those for copra and copra products in Table VI. Tables VII and VIII show the Singapore prices and pan-Malayan export figures for various agricultural products.

Table I

AVERAGE MONTHLY PRICES PAID BY LOCAL DEALERS FOR SMALLHOLDERS' RUBBER, JULY TO SEPTEMBER, 1957

(dollars per pikul*)

Grades	Taiping, Perak			Seremban, Negri Sembilan			Batu Pahat, Johore		
	July	August	Sept.	July	August	Sept.	July	August	Sept.
Smoked Sheet No. 1	104.33	102.67	96.45	104.90	103.08	97.41	—	—	—
Smoked Sheet No. 2	103.43	101.64	95.28	103.68	102.20	95.78	102.36	100.93	94.17
Scrap	48.94	48.07	45.77	58.59	58.18	55.01	36.08	34.50	29.32

* 1 pikul = 133⅓ lb.

This table has been compiled from statistics supplied by the Chief Statistician, Federation of Malaya.

Table II

RUBBER PRODUCTION
FEDERATION OF MALAYA

(long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1956	1957	1956	1957	1956	1957
January -	32,515	36,076	26,428	27,184	58,943	63,260
February -	27,503	27,002	23,848	21,998	51,351	49,000
March -	28,408	25,908	22,433	20,915	50,841	46,823
April -	26,591	26,501	21,647	22,460	48,238	48,961
May -	23,389	27,129	19,703	18,305	43,092	45,434
June -	29,409	29,628	23,109	21,583	52,518	51,211
July -	30,709	32,405	23,807	24,054	54,516	56,459
August -	30,201	32,957	22,927	23,119	53,128	56,076
September -	30,123	31,418	21,774	21,374	51,897	52,792
October -	30,386	33,290	22,455	22,462	52,841	55,752
November -	28,363		21,179		49,542	
December -	34,636		24,058		58,694	
Total -	352,233		273,368		625,601	
Total 1955 -	351,802		285,281		637,083	

This table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

Production on smallholdings (estates of less than 100 acres) is taken as the total of purchases from smallholders reported by licensed dealers.

Table III

AVERAGE PRICES PAID IN LONDON FOR TEA

(s.d. per lb.)

For the Week Ending	Malayan		Ceylon		Indonesian		India				Africa	
							Northern		Southern			
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
4.7.57	3	1.74	4	3.01	3	1.82	3	10.23	3	6.18	3	0.33
11.7.57	3	1.13	4	3.13	3	3.29	3	11.19	3	6.52	3	1.92
18.7.57	3	6.44	4	4.40	3	4.19	3	10.97	3	6.11	3	1.53
25.7.57	3	8.60	4	5.37	2	11.55	4	0.39	3	6.24	3	1.12
1.8.57	3	5.39	4	3.68	2	10.13	4	3.37	3	4.62	3	0.24
15.8.57	4	7.22	4	2.99		Nil	4	3.06	3	6.89	3	0.56
22.8.57	3	2.61	4	2.74	2	10.29	6	2.93	3	6.73	2	11.59
29.8.57	3	3.84	4	2.96	3	1.00	5	3.51	3	6.57	2	10.80
5.9.57	3	7.19	4	7.24	3	0.99	4	5.09	3	5.51	2	10.18
12.9.57	3	10.47	5	2.12		Nil	6	7.79	3	4.96	2	11.20
19.9.57	3	5.42	5	3.97	2	9.93	6	3.37	3	3.80	2	9.70
26.9.57	3	4.25	5	2.94	1	1.23	6	0.21	3	3.16	2	8.35

Table IV

AVERAGE DEALERS' PRICES FOR DRIED LIBERICAN COFFEE BEANS GROWN IN SELANGOR*

(dollars per pikul †)

For the Week Ending	Klang	Kuala Langat
	$	$
6-7-57	130.00	130.00
13-7-57	132.00	130.00
20-7-57	134.00	133.00
27-7-57	136.00	134.00
3-8-57	137.00	135.00
10-8-57	137.00	136.00
17-8-57	140.00	140.00
24-8-57	138.00	135.00
31-8-57	144.00	140.00
7-9-57	146.00	141.00
14-9-57	144.00	140.00
21-9-57	144.00	142.00
28-9-57	142.00	141.00
5-10-57	144.00	144.00
12-10-57	140.00	145.00
19-10-57	140.00	140.00
26-10-57	139.00	139.00
2-11-57	136.00	134.00
9-11-57	138.00	134.00
16-11-57	135.00	133.00
23-11-57	140.00	139.00
30-11-57	144.00	139.00
7-12-57	148.00	145.00
14-12-57	152.00	149.00
21-12-57	150.00	140.00
28-12-57	152.00	154.00

* These are not the prices paid to smallholders, who sell freshly harvested berries to dealers for processing.

† 1 pikul = 133⅓ lb.

Table V

PRODUCTION OF PALM OIL AND KERNELS AND PRICES OF PALM OIL

(long tons, as declared by estates)

Month	Production of Palm Oil (long tons)		Production of Palm Kernels (long tons)		Average Price per Ton of Palm Oil *		
	1956	1957	1956	1957	1957		
					£	s.	d.
January	3,712	3,527	1,038	921	90	10	0
February	3,697	3,572	1,013	926	91	16	9
March	4,520	4,828	1,229	1,225	91	15	0
April	4,105	4,585	1,069	1,168	89	16	7
May	4,364	4,689	1,096	1,096	86	15	0
June	5,263	5,140	1,310	1,203	86	14	4
July	4,977	5,823	1,210	1,480	85	0	0
August	5,303	5,355	1,383	1,445	82	19	0
September	5,098	5,666	1,285	1,408	82	2	0
October	5,387	5,896	1,411	1,465	82	7	0
November	4,842		1,233		78	14	0
December	4,654		1,208		78	9	0
Total	55,922		14,495		£85	11	8

* F.O.B. London,

Table VI

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE
FEDERATION OF MALAYA

(tons)

Month	Copra Production						Coconut Oil Production *		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957
January	2,728	2,473	7,808	8,454	10,536	10,927	8,247	8,272	5,197	5,160
February	2,713	2,339	8,457	5,916	11,170	8,255	7,369	7,919	4,612	4,803
March	3,032	2,725	6,463	5,510	9,495	8,235	8,456	8,077	4,242	5,340
April	2,878	2,849	7,188	6,975	10,066	9,824	7,916	6,618	4,855	4,245
May	2,813	3,098	11,015	8,185	13,828	11,283	8,729	6,614	5,434	4,163
June	3,133	3,513	9,457	7,235	12,590	10,748	9,193	8,541	5,731	5,405
July	3.860	4.105	10,971	10,456	14,831	14,561	9,410	8,879	5,849	5,649
August	4,140	3,488	14,000	10,865	18,140	14,353	11,447	8,775	7,152	5,528
September	3,986	3,195	12,896	7,948	16,882	11,143	9,567	8,704	6,028	5,470
October	3,807	2,880	10,605	9,935	14,412	12,815	9,403	9,174	6,263	5,753
November	2,992		8,291		11,283		9,195		5,739	
December	2,927		7,804		10,821		9,438		5,726	
Total	39,009		115,045		154,054		108,373		67,808	

Notes:—1. The above table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared byestates and oil mills, respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

* Includes both refined and crude oil.

Table VII

SINGAPORE PRICES OF VARIOUS AGRICULTURAL PRODUCTS
(dollars per pikul †)

Date	Copra, Sundried	Coconut Oil	Pepper, F.A.Q. Muntok White	Pepper, Gen. Muntok White	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1- 7-57	26.00	44.75	113.00	125.00	66.00	10.12	15.75	12.50
9- 7-57	26.50	45.00	108.50	118.50	66.00	10.00	15.75	12.00
15- 7-57	26.50	45.50	109.50	119.50	65.00	9.50	15.75	12.00
22- 7-57	27.00	45.75	109.00	119.00	65.00	9.50	15.75	12.00
29- 7-57	26.25	45.75	109.50	119.50	65.00	9.50	15.75	11.00
6- 8-57	26.00	45.25	110.50	100.50	65.00	9.50	15.75	12.00
12- 8-57	26.00	45.25	111.50	101.50	65.00	5.51	16.00	11.75
19- 8-57	25.75	45.00	110.00	100.00	65.00	9.25	16.00	11.00
26- 8-57	25.75	45.25	114.50	124.50	65.00	9.25	16.00	10.00
2- 9-57	25.75	45.25	115.00	125.00	60.00	9.50	16.00	10.00
9- 9-57	25.63	45.00	114.50	124.50	65.00	9.25	16.00	10.00
17- 9-57	25.75	45.00	115.50	123.50	58.00	9.25	16.00	11.00
23- 9-57	25.00	44.75	114.50	124.50	60.00	9.25	16.00	11.00
30- 9-57	25.50	44.25	112.50	122.50	60.00	9.37	16.00	9.50
8-10-57	25.25	44.25	110.00	120.00	60.00	9.37	17.00	9.50
14-10-57	25.50	44.50	104.50	114.50	60.00	9.37	17.00	9.50
21-10-57	26.00	45.50	108.50	118.50	55.00	9.37	16.50	10.00
28-10-57	26.00	45.50	107.50	117.50	55.00	9.37	16.50	9.50

† 1 pikul = 133⅓ lb.
* F.O.B. in second-hand drums.
‡ Nominal.
The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

Table VIII

MALAYAN AGRICULTURAL EXPORTS, JANUARY TO SEPTEMBER, 1957

Product	Net Exports in Tons			Value of Net Exports, C.I.F. ($)
	Year 1955	Year 1956	Jan.-Sept., 1957	Jan.-Sept., 1957
Arecanuts	13,679	11,228	9,031	9,786,034
Coconuts, fresh †	72,140	34,779	34,696	607,385
Coconut oil	91,176	103,132	73,633	55,053,739
Copra	75,076 *	82,549 *	50,994 *	18,511,630 *
Copra cake	56,404 *	66,174 *	59,873 *	9,455,653 *
Gambier, all kinds	66	96	138	659,907
Palm Oil	52,832	55,252	41,428	31,650,377
Pineapples, canned	27,756	30,377	28,807	25,915,548
Sago, flour	23,053	21,483	15,852	3,228,178
Sago, pearl	5,483	4,276	2,852	770,460
Sago, raw	18,709 *	18,522 *	11,368 *	704,138 *
Tapioca, flake	475	260	380	150,077
Tapioca, flour	3,979 *	3,753 *	1,435 *	382,024 *
Tapioca, pearl	5,470	5,630	4,508	1,370,284

† hundreds. net imports.

Table IX

FEDERATION OF MALAYA RICE STATISTICS

Summary of Acreages and Production, 1956-1957 Season

TOTAL WET AND DRY PADI

State or Settlement (1)	Area Planted (2)		Area Destroyed (3)		Area Harvested (4)		Production		
							Padi (5)		Rice (6)
	acres	per cent of total	acres	per cent of (2)	acres	per cent of (2)	gantangs ('000s)	per cent of total	tons
Perlis	58,370	6.6	0	0.0	58,370	100.0	28,074	9.2	44,210
Kedah	286,260	32.3	2,470	0.9	283,790	99.1	114,362	37.3	180,100
Kelantan	183,060	20.6	1,870	1.0	181,190	99.0	52,090	17.0	82,030
Trengganu	52,070	5.9	850	1.6	51,220	98.4	10,535	3.4	16,590
Penang and P. Wellesley	39,070	4.4	200	0.5	38,870	99.5	13,796	4.5	21,730
Perak	114,380	12.9	0	0.0	114,380	100.0	35,705	11.6	56,230
Selangor	43,420	4.9	30	0.1	43,390	99.9	20,566	6.7	32,390
Pahang	40,660	4.6	0	0.0	40,650	100.0	9,199	3.0	14,490
Negri Sembilan	31,560	3.6	830	2.6	30,730	97.4	9,742	3.2	15,340
Malacca	30,300	3.4	1,010	3.3	29,290	96.7	10,623	3.5	16,730
Johore	8,350	0.9	630	7.5	7,720	92.5	1,867	0.6	2,940
Total, Main Crop	887,500	—	7,900	0.9	879,600	99.1	306,559	—	482,770
Off-Season Crop, 1956	9,010	—	60	0.7	8,950	99.3	3,049	—	4,800
Total, 1956-1957 Main and Off-Season Crops	896,510	—	7,960	0.9	888,550	99.1	309,608	—	487,570
Total, 1955-1956 Main and Off-Season Crops	875,880	—	15,650	1.8	860,230	98.2	266,744	—	420,070

Acreage to nearest 10 acres.
Rice production to nearest 10 tons.
Conversion rates: 635 gantangs padi = 1 ton rice.
1 gantang padi = 5.6 lb. padi.
1 gantang padi = 3.528 lb. rice. (i.e. milling recovery of 63 per cent).

Table X

FEDERATION OF MALAYA RICE STATISTICS

Summary of Acreages and Production, 1956-1957 Season

WET PADI

State or Settlement (1)	Area Planted (2)		Area Destroyed (3)		Area Harvested (4)		Average Yield per Acre			Production			Remarks (9)
							Padi (5)	per cent of main season average yield	Rice (6)	Padi (7)	per cent of total	Rice (8)	
	acres	per cent of total	acres	per cent of (2)	acres	per cent of (2)	gantangs		lb.	gantangs ('000s)		tons	
Perlis	58,190	7.0	—	—	58,190	100.0	482	134.6	1,700	28,032	9.5	44,140	107 acres partially damaged due to pests, diseases, drought and floods.
Kedah	281,500	33.8	2,120	0.8	279,380	99.2	406	113.4	1,432	113,453	38.4	178,670	2,120 acres totally damaged by pests, diseases, flood, drought and sea water; 4,401 acres partially damaged by pests, diseases, flood, drought and sea water.
Kelantan	147,220	17.7	1,770	1.2	145,450	98.8	303	84.6	1,069	44,072	14.9	69,400	1,770 acres not harvested due to floods, late planting, damage by salt water and pest damage.
Trengganu	42,600	5.1	770	1.8	41,830	98.2	221	61.7	780	9,228	3.1	14,532	770 acres not harvested due to floods.
Penang and P. Wellesley	38,970	4.7	200	0.5	38,770	99.5	355	99.2	1,252	13,757	4.7	21,660	200 acres not harvested due to drought.
Perak	111,090	13.4	—	—	111,090	100.0	316	88.3	1,115	35,113	11.9	55,300	
Selangor	43,410	5.1	30	0.1	43,380	99.9	474	132.4	1,672	20,565	7.0	32,390	30 acres not harvested due to crop failure and neglect.
Pahang	39,490	4.7	—	—	39,480	100.0	226	63.1	797	8,938	3.0	14,080	
Negri Sembilan	31,260	3.8	530	1.7	30,730	98.3	316	88.3	1,115	9,742	3.3	15,340	530 acres not harvested due to crop failure caused mainly by late planting, shortage of water and pest damage.
Malacca	30,300	3.6	1,010	3.3	29,290	96.7	363	101.4	1,281	10,623	3.6	16,730	1,010 acres not harvested due to drought, flood, empty grains and pests.
Johore	8,350	1.0	630	7.6	7,720	92.4	242	67.6	854	1,867	0.6	2,940	630 acres not harvested due to floods and crop failure.
Total, 1956-57 Main Crop	832,380	100.0	7,070	0.8	825,310	99.2	358	100.0	1,263	295,390	100.0	465,180	
Off-Season Crop, 1956	9,010	—	60	0.7	8,950	99.3	341	—	1,203	3,049	—	4,800	60 acres destroyed by padi blast.
Total, 1956-57 Main and Off-Season Crops	841,390	—	7,130	0.8	834,260	99.2	358	—	1,263	298,439	—	469,980	
Total, 1955-56 Main and Off-Season Crops	825,210	—	15,300	1.9	809,910	98.1	314	99.7	1,119	257,647	—	405,740	

Acreage to nearest 10 acres.
Rice production to nearest 10 tons.
Conversion rates: 635 gantangs padi = 1 ton rice.
1 gantang padi = 5.6 lb. padi.
1 gantang padi = 3.528 lb. rice. (i.e. milling recovery of 63 per cent).

Table XI

FEDERATION OF MALAYA RICE STATISTICS

Summary of Acreages and Production, 1955-1956 Season

UPLAND DRY PADI

State or Settlement (1)	Area Planted (2)		Area Destroyed (3)		Area Harvested (4)		Average Yield per Acre		Production				Remarks (9)
							Padi (5)		Rice (6)	Padi (7)		Rice (8)	
	acres	per cent of total	acres	per cent of (2)	acres	per cent of (2)	gantangs	per cent of main season average yield	lb.	gantangs ('000s)	per cent of total	tons	
Perlis	180	1.3	—	—	180	100.0	232	86.2	819	42	1.2	70	
Kedah	2,880	21.6	—	—	2,880	100.0	206	76.6	727	592	16.8	930	
Kelantan	5,600	42.0	—	—	5,600	100.0	396	147.2	1,397	2,219	63.3	3,490	
Trengganu	2,460	18.5	—	—	2,460	100.0	134	49.8	473	329	9.4	520	
Penang and P. Wellesley	—	—	—	—	—	—	—	—	—	—	—	—	
Perak	1,910	14.3	—	—	1,910	100.0	170	63.2	600	325	9.3	510	
Selangor	—	—	—	—	—	—	—	—	—	—	—	—	
Pahang	—	—	—	—	—	—	—	—	—	—	—	—	
Negri Sembilan	300	2.3	300	100.0	—	0.0	—	—	—	—	—	—	Crop planted by aborigines. Total failure due to drought.
Malacca	—	—	—	—	—	—	—	—	—	—	—	—	
Johore	—	—	—	—	—	—	—	—	—	—	—	—	
Total, Main Crop	13,330	100.0	300	2.3	13,030	97.7	269	100.0	949	3,507	100.0	5,530	
Off-Season Crop, 1956	—	—	—	—	—	—	—	—	—	—	—	—	
Total, 1956-57 Main and Off-Season Crops	13,330	—	300	2.3	13,030	97.7	269	—	949	3,507	—	5,530	
Total, 1955-56 Main and Off-Season Crops	See figures on the table for lowland dry padi. Separate data for upland and lowland padi were not collected for 1955-56.												

Acreage to nearest 10 acres.
Rice production to nearest 10 tons.
Conversion rates: 635 gantangs padi = 1 ton rice.
1 gantang padi = 5.6 lb. padi.
1 gantang padi = 3.528 lb. rice (i.e. milling recovery of 63 per cent).

Table XII

FEDERATION OF MALAYA RICE STATISTICS

Summary of Acreages and Production, 1955-1956 Season

LOWLAND DRY PADI

State or Settlement (1)	Area Planted (2)		Area Destroyed (3)		Area Harvested (4)		Average Yield per Acre			Production			Remarks (9)
							Padi (5)	per cent of main season average yield	Rice (6)	Padi (7)	per cent of total	Rice (8)	
	acres	per cent of total	acres	per cent of (2)	acres	per cent of (2)	gantangs		lb.	gantangs ('000s)		tons	
Perlis	—	—	—	—	—	—	—	—	—	—	—	—	323 acres destroyed by floods. 13 acres by pests, and 14 acres by drought.
Kedah	1,880	4.5	350	18.6	1,530	81.4	207	111.3	731	317	4.1	500	Elephants destroyed 50 acres; 50 acres were not harvested due to late planting.
Kelantan	30,240	72.4	100	0.3	30,140	99.7	192	103.2	677	5,799	75.7	9,130	80 acres destroyed by floods.
Trengganu	7,010	16.8	80	1.1	6,930	98.9	141	75.8	498	978	12.8	1,540	
Penang and P. Wellesley	100	0.2	—	—	100	100.0	393	211.3	1,387	39	0.5	60	
Perak	1,380	3.3	—	—	1,380	100.0	194	104.3	685	267	3.5	420	
Selangor	10	—	—	—	10	100.0	104	55.9	367	1	0.0	—	
Pahang	1,170	2.8	—	—	1,170	100.0	222	119.4	784	261	3.4	410	
Negri Sembilan	—	—	—	—	—	—	—	—	—	—	—	—	
Malacca	—	—	—	—	—	—	—	—	—	—	—	—	
Johore	—	—	—	—	—	—	—	—	—	—	—	—	
Total, 1956-57 Main Crop	41,790	100.0	530	1.3	41,260	98.7	186	100.0	656	7,662	100.0	12,070	
Off-Season Crop, 1956	—	—	—	—	—	—	—	—	—	—	—	—	
Total, 1956-57 Main and Off-Season Crops	41,790	—	530	1.3	41,260	98.7	186	—	656	7,662	—	12,070	
Total, 1955-56 Main and Off-Season Crops *	50,670	—	350	.7	50,320	99.3	181	100.0	637	9,100	—	14,330	

* Figures for upland and lowland dry padi combined.

Acreage to nearest 10 acres.
Rice production to nearest 10 tons.
Conversion rates: 635 gantangs padi = 1 ton rice.
1 gantang padi = 5.6 lb. padi.
1 gantang padi = 3.528 lb. rice. (i.e. milling recovery of 63 per cent).

METEOROLOGICAL SUMMARY, MALAYA, SEPTEMBER, 1957

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet				Number of Days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F	° F	Total		Most in a day Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	92.1	73.7	82.9	95.4	70.6	89.2	76.3	87.4	222.0	8.74	222.0	2.60	16	11	6			184.70	6.16	
Kuala Lumpur, Selangor	89.9	73.1	81.5	92.6	70.8	84.7	75.1	65.2	165.6	6.52	165.6	1.61	16	14	7			184.30	6.14	
Sitiawan, Perak	88.7	72.9	80.8	91.4	69.8	84.2	75.9	83.6	85.2	10.64	270.3	2.24	17	15	4			170.65	5.69	
Kuantan, Pahang	89.4	72.6	81.0	92.0	68.0	85.6	74.4	83.2		6.27	159.3	1.62	20	18	9	2		174.95	5.83	
Bayan Lepas, Penang	86.7	74.3	72.9	89.4	71.6	81.4	76.8			19.54	496.3	3.79	19	17	3			147.10	4.90	
Malacca	87.0	73.1	80.1	89.2	70.0	82.7	75.9			13.72	348.5	1.96	21	16	7			176.35	5.88	
Mersing, Johore	87.2	71.3	79.3	90.6	69.6	81.6	72.9			9.00	228.6	1.43	19	16				155.60	5.19	
Alor Star, Kedah	87.8	74.3	81.1	91.2	72.2	80.8	76.2			13.07	332.0	2.72	20	19	2			148.85	4.96	
Kota Bharu, Kelantan	87.7	74.3	81.0	90.0	72.2	84.0	77.0	83.1	84.1	15.94	404.9	4.14	20	11				189.25	6.31	
K. Trengganu, Trengganu	87.8	73.4	80.6	89.4	71.7	83.4	75.9			11.28	286.5	2.61	25	18		1		170.83	5.69	
Singapore	86.8	74.5	80.7	90.2	70.0	82.5	76.0			6.76	171.7	1.13	19	15	6			130.00	4.33	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	73.2	57.7	65.5	76.0	49.9	67.8	60.4			7.68	195.1	1.43	21	18				108.80	3.63	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, OCTOBER, 1957

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A.	B.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.						Precipitation 0.01 in. or more	Precipitation 0.04 in. or more	Thunderstorm	Fog morning obs.	Gale force 28 kt. or more			
	Max.	Min.										Amt.								
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	90.7	72.8	81.7	93.8	71.1	85.3	75.1			10.21	259.3	1.59	24	19	7		1	172.35	5.56	
Kuala Lumpur, Selangor	90.1	73.2	81.7	93.0	70.6	84.2	75.0			12.99	329.9	2.99	23	18		7		182.55	5.81	
Sitiawan, Perak	88.7	72.8	80.7	91.3	71.0	82.3	75.1	84.1	85.1	7.49	190.2	2.34	18	17	4			174.50	5.63	
Kuantan, Pahang	88.3	72.1	80.2	92.8	70.0	82.0	74.5	82.8		12.10	307.3	3.39	22	19	6	8		177.05	5.71	
Bayan Lepas, Penang	86.5	73.7	80.1	89.9	70.2	81.8	76.4			15.27	387.9	1.52	25	24	8			181.25	5.85	
Malacca	87.0	73.2	80.1	89.9	70.3	82.1	76.0			5.83	148.1	1.25	19	16	2	1		184.80	5.96	
Mersing, Johore	87.0	73.2	80.1	89.9	70.3	82.1	76.0			7.16	184.9	1.52	15	14				209.85	6.77	
Alor Star, Kedah	88.2	73.8	81.0	92.3	72.1	79.0	75.8			11.46	291.1	2.24	20	18	5	1		195.35	6.30	
Kota Bharu, Kelantan	86.7	74.1	80.4	90.3	70.1	81.2	76.2	83.1	84.5	15.84	402.3	2.20	23	21	11			176.40	5.69	
K. Trengganu, Trengganu	86.0	73.6	79.8	89.8	70.8	79.2	75.7			15.24	387.1	3.37	22	10	1			182.75	5.81	
Singapore	88.4	74.3	81.3	91.6	72.7	83.0	76.0			4.68	118.9	2.33	16	9	4	1		181.40	5.85	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	72.7	56.5	64.6	76.5	51.6	69.0	60.1			13.81	351.3	2.62	28	27				119.15	3.76	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, NOVEMBER, 1957

Locality	Air Temperature Degrees Fahrenheit: Means of A.	Means of B.	Absolute Extremes: Mean Max.	Mean Min.	Highest	Lowest	Mean	Earth Temperature: At 1 foot	At 4 feet	Rainfall: Total	Total	Most in a day	Number of Days: Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	8 or more	Bright Sunshine: Total	Daily Mean
												Amt.							
										in.	mm.	in.						hr.	hr.
Ipoh, Perak	91.2	73.2	82.0	95.5	67.6	81.4	75.4			11.60	294.6	2.07	20	17	3			181.60	6.05
Kuala Lumpur, Selangor	90.6	73.4	82.0	94.0	70.3	87.1	75.3			14.80	375.9	3.21	25	20	8			172.00	5.73
Sitiawan, Perak	88.2	73.1	80.7	94.2	70.0	80.2	74.8	84.1	85.1	10.52	267.2	2.66	18	16	7	2		193.80	6.46
Kuantan, Pahang	86.6	71.9	79.1	90.9	68.4	77.0	73.5	81.5		17.01	432.1	3.58	20	19	4	3		157.15	5.24
Bayan Lepas, Penang ...	87.4	74.6	81.0	90.4	72.9	84.7	78.8			11.76	298.7	3.10	18	17	7			219.45	7.31
Malacca	88.0	73.4	80.7	91.1	70.2	82.0	75.0			13.12	333.2	3.36	18	16	8			187.65	6.25
Mersing, Johore	85.6	72.0	78.8	88.4	69.8	78.1	74.0			13.96	354.6	4.92	16	14				181.30	6.04
Alor Star, Kedah	89.9	73.7	81.8	96.1	71.5	85.6	76.6			5.67	144.0	2.78	16	8	2			223.90	7.46
Kota Bharu, Kelantan ...	85.0	72.1	80.1	90.0	71.1	79.5	76.8	83.2	84.0	8.91	226.3	1.60	18	14	2	3		181.25	6.04
K. Trengganu, Trengganu	84.5	73.4	78.9	88.4	72.0	79.0	75.3			12.85	326.4	3.91	24	20				177.55	5.92
Singapore	87.8	74.5	81.1	92.2	72.5	81.7	78.2			8.40	213.4	1.78	21	17	7			141.85	4.73
HILL STATION																			
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	72.2	56.7	64.9	76.2	53.8	69.7	61.3			13.19	335.0	1.75	30	24				122.25	4.07

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, DECEMBER, 1957

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall							Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days				Total	Daily Mean	Per cent.
	A.	B.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.						Precipitation .01 in. or more	Precipitation .04 in. or more	Thunder	Fog morning obs.			
	Max.	Min.						° F	° F										
										in.	mm.	in.					hr.	hr.	
Ipoh, Perak	87.1	73.5	80.3	90.0	70.0	82.0	75.2			9.41	239.0	2.17	19	16	5		127.35	4.11	
Kuala Lumpur, Selangor	89.9	73.6	80.7	91.8	71.3	79.1	75.4			14.28	362.7	3.56	20	17	5	7	107.75	3.47	
Sitiawan, Perak	87.1	73.5	80.5	90.0	70.0	82.0	75.2	83.1	84.5	12.68	322.1	1.68	23	22	7	3	133.15	4.29	
Kuantan, Pahang	81.7	73.1	77.4	86.8	71.1	74.3	75.1	78.5		49.16	1248.7	7.91	29	27	1		40.95	1.32	
Bayan Lepas, Penang	87.5	74.3	80.9	90.0	71.8	83.6	77.3			2.66	67.6	0.43	17	13	4		156.55	5.05	
Malacca	85.5	73.0	79.3	89.1	71.1	78.7	74.7			9.31	236.5	1.96	20	16	4	1	90.40	2.92	
Mersing, Johore	87.3	72.3	76.8	86.2	70.0	75.1	74.9			32.65	829.3	5.38	27	26		2	56.25	1.81	
Alor Star, Kedah	87.9	73.1	80.5	91.4	70.2	83.8	76.0			2.85	72.4	1.04	12	9			177.05	5.71	
Kota Bharu, Kelantan	83.6	75.1	79.3	85.3	71.2	79.7	79.0	80.2	81.1	24.17	613.9	5.72	22	18	1	2	99.25	3.20	
K. Trengganu, Trengganu	82.3	74.2	78.3	85.0	70.9	78.0	78.3			34.09	865.9	7.78	30	27			79.10	2.55	
Singapore	84.5	73.9	79.2	89.0	70.3	77.5	75.2			16.35	415.3	2.60	23	21	6		90.85	2.93	
HILL STATION																			
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	71.8	59.0	65.4	74.4	52.5	68.3	62.0			9.42	239.3	1.50	27	24			49.90	1.61	

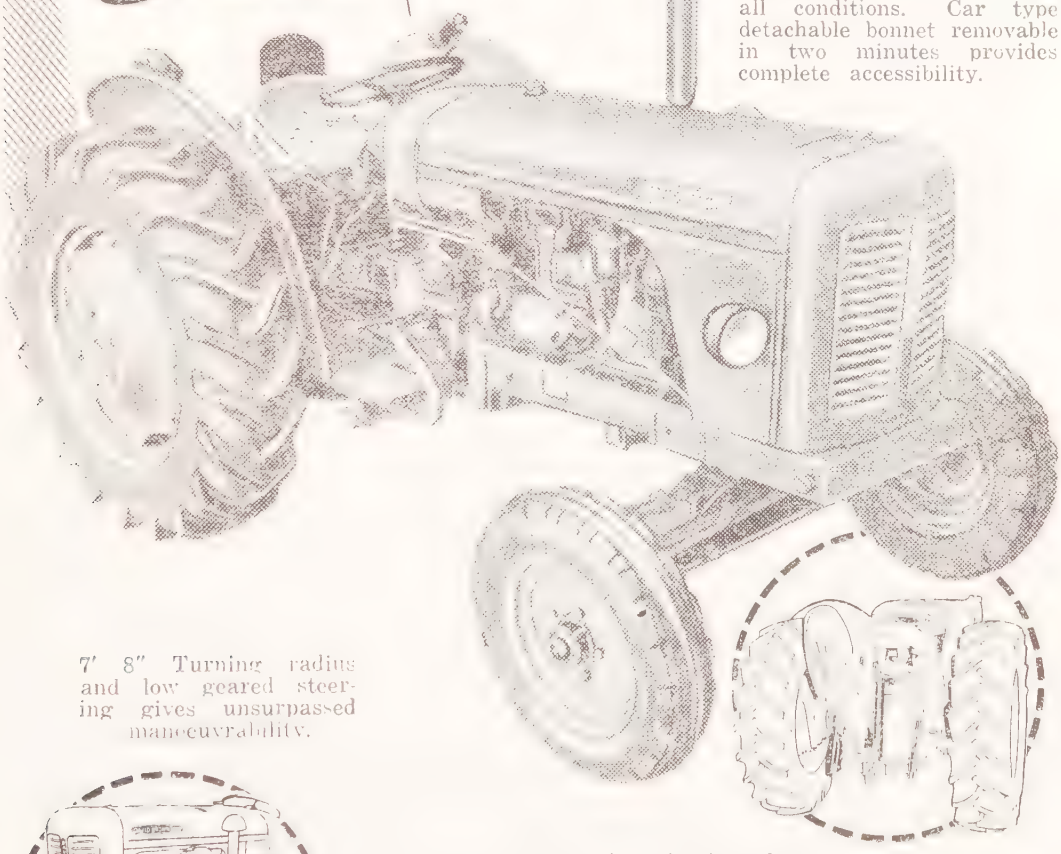
Compiled from returns supplied by the Malayan Meteorological Service.

DAVID BROWN

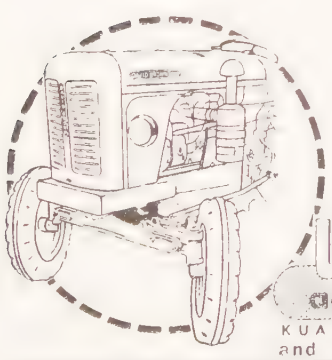
900

New features and proved features

The new powerful David Brown 900 with its 40 H.P. diesel engine and patent traction control unit gives unsurpassed traction under all conditions. Car type detachable bonnet removable in two minutes provides complete accessibility.



7′ 8″ Turning radius and low geared steering gives unsurpassed manoeuvrability.



Hydraulic lift for the heaviest implements, with category one or two linkages.

Wearne's

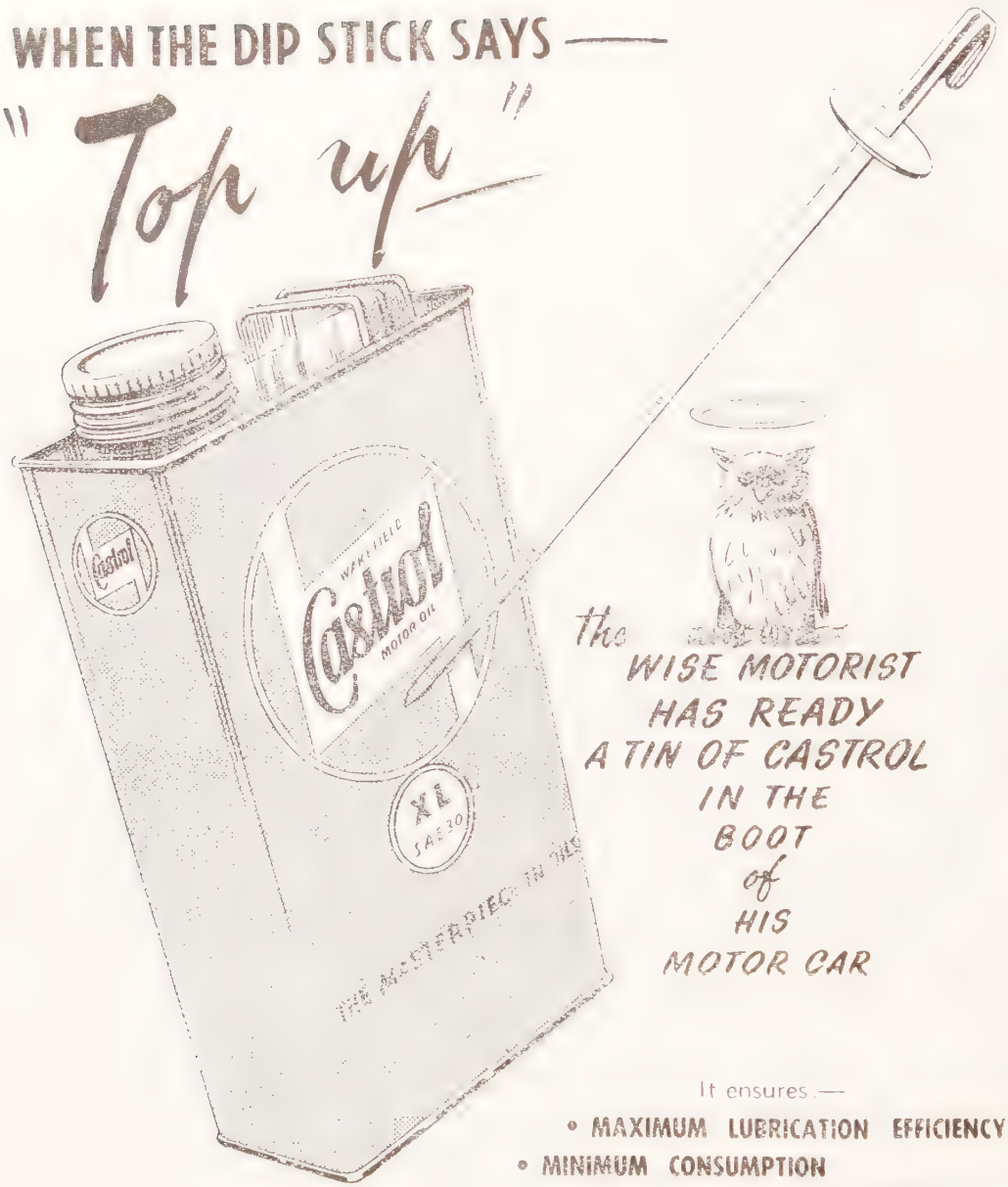
agricultural and heavy equipment division

KUALA LUMPUR — PENANG — IPOH — SEREMBAN — MALACCA

and at FEDERATED MOTORS LIMITED, SINGAPORE

WHEN THE DIP STICK SAYS —

"Top up"



the WISE MOTORIST HAS READY A TIN OF CASTROL IN THE BOOT of HIS MOTOR CAR

It ensures —

- MAXIMUM LUBRICATION EFFICIENCY
- MINIMUM CONSUMPTION OF OIL AND PETROL
- IT REDUCES WEAR AND TEAR OF ENGINE RUNNING PARTS

Castrol — THE MASTERPIECE IN OILS

C. C. WAKEFIELD & CO., LTD.,
KUALA LUMPUR — SINGAPORE — PENANG

BETTER COPRA . . .

the "CHULA" way

* Quicker
* easier
* more economical

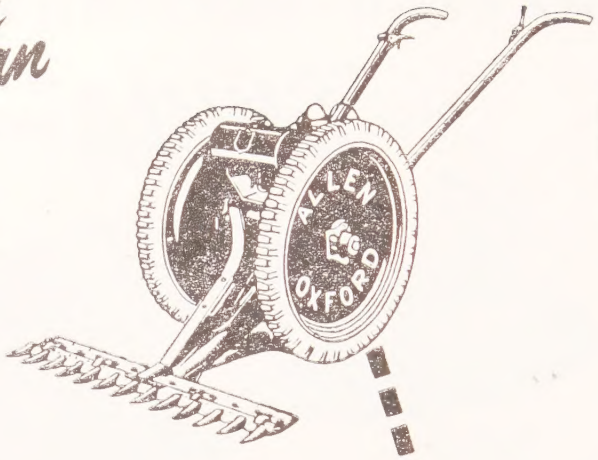
Practical experience has proved that, where "CHULA" Copra Dryers are used, better quality Copra is produced when dried by this scientific process. No discolouration, free from mould, thoroughly and evenly dried throughout, Copra can be produced the whole year round—irrespective of the weather. By the way, are you growing RUBBER? If so, let us supply you with the latest Huttenbach Rubber Machinery. Further information gladly supplied on request.

Agents: **PAPUA:** The B.N.G. Trading Co. Ltd., Port Moresby.
NEW GUINEA: Burns Philp (New Guinea) Ltd., Rabaul, Lae, Madang and Kavieng.
FIJI, SAMOA, TONGA: Morris Hedstrom Ltd., Suva, Fiji.
SOLOMON ISLANDS: K. H. Dalrymple Hay Esq., Honiara.

Tyneside Foundry & Engineering Co., Ltd.

Patentees and Sole Manufacturers Established 1898
Elswick - Newcastle upon Tyne - England
Cables: "Foundry, Newcastle-on-Tyne." Codes: ABC 5th & 6th Editions.
Agents in Malaya: Sime Darby & Co., Ltd., Singapore.

Wherever a man can follow— the ALLEN Scythe will cut



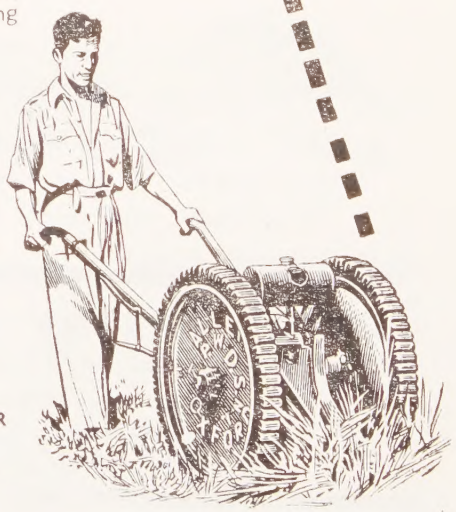
Sime Darby 羊那荷

THE ALLEN SELF-PROPELLED MOTOR SCYTHE embodies the great experience gained during the twenty three years of manufacturing this machine, and is the result of continuous, careful study of the differing requirements of users throughout the world.

The 3 h.p. engine drives both the cutting mechanism and road wheels. There is ample power to drive the scythe even through dense lallang and high blukar and it will climb steep hillsides up to 1 in 1 quite easily. The scythe is simple to operate, and has proved its worth to estates, municipalities, and P.W.D. in all parts of Malaya and Singapore.

The Model "TS" is now available and incorporates several improvements, the chief of which is a mechanical Servo clutch withdrawal mechanism. It is also fitted with a longer axle for greater stability on slopes, Forestry Guards to allow a better flow of the cut material, and Allen patent adjustable pads, which ensure correct adjustment of the cutting assembly.

There's always a job for the ALLEN



ATTACHMENTS

- SPRAY PUMP
- CENTRIFUGAL PUMPS
- HOES AND CULTIVATORS
- HORTICULTURAL PLOUGH
- CIRCULAR SAW
- MOWER ROLLER
- TRAILER SEAT
- CARRIER
- TRAILER
- KNIFE SHARPENER
- VACUUM PUMP

THE

MAHA MAGAZINE

KEEN GARDENERS—

AND THOSE NOT YET SO KEEN—

WILL ALL BE INTERESTED IN THE NEW EDITION

OF THE MAHA MAGAZINE

HORTICULTURE

Livestock

IN KAMPONG & COUNTRYSIDE

The Post Bag

ASK YOUR BOOKSELLER

or

Apply to Secretaries:

Messrs. WALGRENS LTD.,

Kwong Yik Chambers, High Street, Kuala Lumpur.

DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA.

The Director of Agriculture invites those interested to visit the College of Agriculture, Serdang, Selangor, and the various Federal and State Stations throughout the Federation Malaya. Intending visitors to the College of Agriculture should communicate with the Principal; to the Federal Experiment Station, Serdang, Selangor, with the Agronomist-in-charge; and to other Federal and State Stations with the State Agricultural Officers. The following is a list of Agricultural Stations on which can be studied the more important lines of investigation and extension at present carried out by the Department.

Correspondence concerning the experiments at any of these Stations should, if it originates in Malaya, be addressed to the State Agricultural Officer, concerned; correspondence originating in any other country should be addressed to the Director of Agriculture, Federation of Malaya, Kuala Lumpur.

Wet Padi.

SELECTION WORK. Telok Chengai, Kedah; Titi Serong, Simpang Tiga and Talang, Perak; Pulau Gadong, Malacca; Kota Bharu and Jelawat, Kelantan; Kendong, Ulu Klawang and Ampang Tinggi, Negri Sembilan; Sungei Burong and Panchang Bedena, Selangor; Genting and Bukit Merah, Penang and Province Wellesley; and other State Stations.

AGRONOMIC INVESTIGATIONS. Most Padi Experiment and Test Stations.

Dry Padi.

Melor, Kelantan, and Paya Besar, Pahang.

Rubber.

Budwood and clonal seedling nurseries. Most State Agricultural Stations. Replanting demonstration plots in all States.

Tea.

Federal Experiment Station, Cameron Highlands.

Oil Palm.

Federal Experiment Stations, Serdang, Selangor, and Jerangau, Trengganu.

Coconut.

Federal Experiment Station, Telok Bharu, Perak, and Coconut (Rehabilitation) Station, Sungei Sudah, Muar, Johore.

Cacao.

FEDERAL EXPERIMENT STATIONS. Serdang, Selangor, and Jerangau, Trengganu.

AMELONADO SEED GARDENS. Sik, Kedah; Batang Merbau, Kelantan; Ayer Itam, Penang; Layang Layang Kiri and Bukit Gantang, Perak; Temerloh, Kuala Lipis and Pekan, Pahang; Ampang Tinggi, Negri Sembilan; Sungei Udang, Malacca; Ayer Hitam, Johore; Sungei Tong, Trengganu.

Pineapple.

Jalan Kebun, Selangor, and Alor Bukit, Johore.

Manila Hemp.

Federal Experiment Station, Serdang, Selangor; Degong, Perak; and Sungei Ruan, Pahang.

Fruit Propagation.

Federal Experiment Station, Serdang, and all State Agricultural Stations.

Vegetables.

Federal Experiment Stations, Kuala Lumpur and Cameron Highlands.

Poultry.

Federal Experiment Station, Cameron Highlands and most State Agricultural Stations.

Livestock.

PIGS: Federal Experiment Stations, Serdang and Cameron Highlands; Sungei Buloh and Jenjarom, Selangor; Mah San, Negri Sembilan; Raja Hitam (Dindings) and Teluk Bharu, Perak; Pulau Gadong, Malacca; and Ayer Itam, Penang.

GOATS: Ayer Itam, Penang; Bukit Mertajam, Province Wellesley; Sungei Udang, Malacca; Cheras, Setapak, Sabak Bernam and Federal Experiment Station, Serdang, Selangor; Chembong, Negri Sembilan.

Pastures.

Federal Experiment Station, Serdang, Selangor.

PRINTED BY THE ECONOMY PRINTERS LTD., KUALA LUMPUR.